United States Court of Appeals

for the

District of Columbia Circuit

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DISTRICT OF COLUMBIA

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IN THE

United States Court of Appeals

DISTRICT OF COLUMBIA.

No. 8859 606

ERNST ZINGG and SULZER FRERES, SOCIETE ANONYME,
Appellants,
vs.
CONWAY P. COE, Commissioner of Patents of the United States of America,
Appellee.

Appeal from the District Court of the United States for the District of Columbia.

BRIEF FOR APPELLANTS.

Norman S. Parker,
Leslie M. Parker,
8 South Michigan Avenue,
Chicago 3, Illinois,

Spencer B. Michael,
William A. Smith,
Woodward Building,
Washington 5, D. C.,
Attorneys for Ernst Zingg and Sulzer Freres Societe Anonyme.

THE GUNTHORP-WARREN PRINTING COMPANY, 210 WEST JACKSON, CHICAGO

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APPELLANT'S BRIEF.

This is an appeal from the adverse decision of the District Court of the United States for the District of Columbia in an action under Section 4915 R. S. (U.S.C., title 35, section 63) in which plaintiffs' appellants sought to have the Court adjudge that they are lawfully entitled to receive a patent containing claims 12 to 16, inclusive, of the patent application of the plaintiff Ernst Zingg, Serial No. 319,597, which was filed in the Pâtent Office on February 19, 1940.

STATEMENT OF THE CASE.

The application relates to a metallic casting in which there is embedded an insert member made of a metal whose modulus of elasticity is different from that of the metal of which the casting is made. A purpose of the invention is to provide the insert so as to diffuse and divert the lines of force which exist in the casting when the same is subjected to a stress, from the more highly stressed parts of the casting toward the less highly stressed parts.

The five following patent claims are involved in this appeal:

> "12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.
>
> 13. A metallic casting having embedded in, completely enclosed by, and integrally attached thereto, a metallic insert member whose modulus of elasticity, is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.
>
> 14. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress, the metallic insert having two surface integrally bonded to the casting, the lines of force intersecting both surfaces.

15. The method of increasing the strength of metal casting which consists of embedding therein in integral relation therewith at least one metallic insert in such a position that it intersects the lines of force in the stressed casting, the modulii of elasticity of the body of the casting and of the insert being so related that the lines of force are diverted from the more highly stressed parts of the casting toward, and diffused in the less highly stressed parts thereof.

16. A metallic casting having regions of higher and regions of lower stresses, a reinforcing member embedded therein, completely enclosed by the body thereof having its entire superficial area integrally attached thereto and located in a region of lower stress, and having a modulus of elasticity greater than the modulus of elasticity of the body of the casting."

The Applicant's Problem.

It has long been recognized that when metal parts are in use and subjected to stress and strain of compression or tension the forces exerted through the metal member are generally described as operating along "lines of force." Almost universally a metal part under load of compression or tension is unequally loaded throughout its total mass. Certain parts do little or no effective work, while the work is concentrated in other parts. In the past, inventors have attempted to correct this condition by uniform or symmetrical reinforcements inserted or associated with the metal member. The effect of such reinforcements is merely to strengthen the article, but does not correct the basic defect and does not result in a condition in which the load or work or lines of force are diverted from the more highly stressed parts to the less highly stressed parts.

The applicant set himself to solve the problem and to provide means in a casting for diverting and diffusing the stresses and the lines of force in order to place added work on parts of the casting which normally would be doing less than their maximum of possible work. Symmetrical or uniform reinforcing does not accomplish this result. Selectively shaped and selectively placed inserts do.

The Applicant's Device.

The device which the applicant has invented and for which patent is now sought is shown in Figures 5, 6, 8 and 9 of the applicant's device. As shown in Figures 5 and 6, relatively small inserts 5 are applied. They do not completely surround the member 2 or the perforation in which it is seated. They do, however, intersect the lines of force in such a manner that they divert and diffuse them, and hence divert and diffuse the load and spread it. This has the important advantage of bringing a much greater percentage of the total metal present in the member 1 under load and diffuses, diverts and spreads the load through a larger proportion of the mass of metal 1 and thus produces a condition in which excessive loading of a limited portion of the mass is prevented.

As will be pointed out in greater detail below, all of the references and the entire cited prior art show reinforcements symmetrically placed about the articles in which they are formed or symmetrically formed themselves. The art thus does not disclose the applicant's invention and does not disclose means for diffusing, diverting or spreading the lines of force from the more highly stressed parts of the member and into the less highly stressed parts.

The prior art generally discloses a recognition of the possibility of strengthening or reinforcing a casting by inserting into it, casting within it, or casting about or against it a reinforcing member of a material having different physical properties from those of the main member and capable of strengthening the main member. That has been the teaching of the prior art throughout. Zingg, the applicant of the application involved herein, has gone directly counter to this teaching. He has not sought to reinforce and has not reinforced his member in the manner of the prior art.

Figures 3 and 4 of the drawings of the Zingg application illustrate the teachings of the prior art, in which a symmetrical and continuing member 4 is positioned about the perforation in which the member 2 is seated. Since the member 4 is of uniform diameter and cross section, it does not effect any diffusion or diversion of the lines of force or the stresses exerted through it. The direction of the lines of force is unaltered by the presence of the member 4 or its equivalent.

In the applicant's solution, which is illustrated in Figures 5 and 6, the most direct lines of force pass through a portion of the member 1 in which the inserts 5 do not lie. Other lines of force, however, do pass through the members 5 and are diverted and diffused by those members. It is important to notice that in the applicant's solution of his problem, his inserts are of less mass than such an insert as the member 4. Frequently the insert material is more expensive than the main material and the applicant secures a greater and a better strengthening of his casting by using a much reduced quantity of the insert material than would be possible in accordance with the teachings of the prior art.

The applicant Zingg has, therefore, not merely gone counter to the teachings of the prior art, but he has, in addition, produced a less expensive structure and at the same time a better structure in which, because the lines of force are diverted and diffused, a much greater proportion of the total mass of metal 1 is brought under load and is required to do full work. In this manner, breakage of the mass is rendered far less likely than is the case in an untreated casting such as shown in Figures 1 and 2 or in a conventionally reinforced casting such as that shown in Figures 3 and 4.

The Claims.

Claims 12, 13, 14 and 15 were in the application during its pendency in the Patent Office before the Primary Examiner, and claim 16 was inserted by amendment and entered for the purpose of appeal. All of the claims were finally rejected in the Patent Office.

Claim 12 may be read upon the structure of Figures 5 and 6 as follows:

I. a metallic casting (1)
    (a) having embedded in and
    (b) integrally attached thereto
II. a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal (5)
    (a) the insert member intersectiing the lines of force in the casting.
    (b) and extending away from the area of maximum stress toward areas of lesser stress (the lines of force are indicated by the numeral 3 in Figure 6).

The reading of the claim on the structure of Figures 5 and 6 is obvious. Some of the lines of force 3 extend generally in a longitudinal direction, as shown in Figure 6, through the mass 1. Others which pass through the members 5 extend away from the perforation in which the member 2 can be seated. In normal operation the maximum stress is exerted in a general right and left direction from the perforation of Figure 6 toward the left hand end of this figure, and this is the area of maximum stress. The lines of force 3 which extend divergently and pass through the inserts 5 will extend toward the areas of lesser stress. The presence of the inserts 5 is thus effective to cause the lines of force to be diffused and diverted and to spread the load more equally than would otherwise be the case.

Claims 13 and 14 need not be analyzed in detail, as they follow generally the form of claim 12. Each of them includes the following statement with regard to the location of the insert member—namely, that it is positioned so as to intersect" * * * the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress." Claims 13 and 14 differ from claim 12 by structural limitations. Claim 13, for example, points out the fact that the insert is "* * * completely enclosed by the casting * * *" Claim 14 differs from claims 12 and 13 by the following structural limitation: "* * * the metallic insert having two surfaces integrally bonded to the casting, the lines of force intersecting both surfaces."

Claim 15 is a method claim and may be analyzed as follows:

> The method of increasing the strength of metal castings which consists in
>
> I. embedding therein
>   (a) in integral relation therewith
>   (b) at least one metallic insert
>   (c) in such a position that it intersects the lines of force in the stressed casting
>
> II. the modulii of elasticity of the body of the casting and of the insert being so related that the lines of force are diverted
>   (a) from the more highly stressed parts of the casting toward and
>   (b) diffused in the less highly stressed parts thereof.

Claim 16 does not appear in the "Examiner's Statement" and may be analyzed as follows:

- I. a metallic casting (1)
  - (a) having regions of higher and
  - (b) regions of lower stresses
- II. a reinforcing member embedded therein (5)
  - (a) completely enclosed by the body thereof
  - (b) having its entire superficial area integrally attached thereto and
  - (c) located in the region of lower stress and
  - (d) having a modulus of elasticity greater than the modulus of elasticity of the body of the casting.

Claims 16 differs from the other article claims by the statement with regard to the insert that it is "* * * located in a region of lower stress * * *" The reading of this phrase on the structure of Figures 5, 6, 8 and 9 is clear. The region of greater stress, as shown in Figure 6, is the region which is located between the inner reduced edges of the members 5. A line drawn horizontally from right to left through the member 1 of Figure 6 passes through the region of greater stress, and from that figure it is clear that the inserts 5 are not in that region, but are in regions of lesser stress, and hence they accomplish the diversion and diffusion of the lines of force and of the stress, which is one of the applicant's purposes.

SUMMARY OF ARGUMENT.

Zingg has produced a means for strengthening a composite structural member. His strengthening means have not been previously produced and none of the patents cited by the Commissioner discloses them.

Zingg has produced a method and means of strengthening a composite member, which method and means run directly counter to the teachings of the prior art. In the prior art, the only means suggested for strengthening a composite member is the insertion in that member or the attachment to the member of a symmetrical and generally uniform strengthening part.

The prior art patents suggest strengthening a composite member by the use of reinforcing means which reinforce directly the parts of the member already the strongest.

Zingg has produced a strengthening means in which the strongest parts of the structural member are not strengthened, but in which the weaker parts are strengthened, and thus he compels the weaker parts to carry a greater proportion of the load.

Of the patents cited by the Commissioner, three should be considered together—namely, Roberts, Eklind and Armstrong. In each of them a member which is of circular cross section is reinforced by a reinforcing member which is also of circular cross section and which is positioned concentrically with the article to be reinforced.

A fourth reference, Westlake, discloses merely the art of casting a reinforcing member of rectangular cross section into a member of different composition, which is also of rectangular cross section.

Two other references, Canda and Trembour, disclose merely the idea of reinforcing a composite bar by casting within it a number of harder reinforcing bars which extend substantially from end to end of the composite bar and are positioned within it.

None of the references cited by the Commissioner shows any attempt to locate a strengthening member selectively within a composite member so as to cause the selective member to intersect and to divert the stresses and the lines of force to compel the less heavily loaded parts of the composite member to assume an additional amount of the stress and load to which the composite member is submitted. None of the patents cited by the Commissioner, singly or combined, tells how to produce Zingg's result or gives any hint or suggestion of steps which can be carried out to divert a portion of the load or stress from the more heavily loaded part of the composite member to the more lightly loaded part.

Zingg has produced a reinforcement for a composite member by means of which, while using a relatively small amount of strengthening material, he accomplishes a substantial strengthening of his composite member by redirecting and redistributing the location of the load and the direction of the lines of force exerted by the load upon the composite member.

Prior Patents Cited by the Commissioner.

One or more of the following references were relied upon by the Patent Office or presented as exhibits by the defendant:

209,836	Roberts	Nov. 12, 1878
980,719	Westlake	Jan. 3, 1911
1,107,755	Canda	Aug. 18, 1914
1,296,373	Dow	Mar. 4, 1919
1,576,317	Eklind	Mar. 9, 1926
1,718,210	Armstrong	June 25, 1929
1,834,750	Trembour	Dec. 1, 1931

At the hearing before the Court the solicitor for the defendant stated that Dow Patent No. 1,296,373 would not be relied upon.

Of the other references, three—namely, Roberts, Eklind and Armstrong—may be considered together. Each shows a symmetrically arranged annular reinforcing ring or sleeve. Each is positioned symmetrically within a member of circular cross section. The purpose of each is merely to provide reinforcing.

United States Patent to Roberts 209,836.

Roberts is concerned primarily with furnishing surface reinforcing, because his reinforcing sleeve *b* surrounds the crank pin of a crank assembly and furnishes a wear resistant part. The reinforcing member *b* of Roberts is a cylindrical sleeve. This sleeve extends entirely about the article and entirely about the area of major strain. It cannot have the effect of diffusing or diverting lines of force or stress or strain from the area of maximum stress toward the area or areas of lesser stress.

In contradistinction to Roberts' device, Zingg has placed his inserts 5 or 10 not in reinforcing position, but in a position in which they divert and diffuse the load and, in effect, cause idle or otherwise little used portions of the member 1 to do useful work. Had Zingg's purpose been to accomplish merely the reinforcing which is accomplished by Roberts' device, he would have used the obsolete structure of his Figures 3 and 4 and instead of his inserts 5 he would have used his insert sleeve 4, extending uniformly and entirely about the perforation which receives the pin 2. If the pin 2 of Zingg's device be inserted in the perforation arranged to receive it, and then the combined member be subjected to tension or compression, the members 5 can give no effective reinforcement in the manner in which the sleeve *b* of Roberts gives reinforcement. They can only effect a dispersal of strains and a prevention of too highly localized strain. Roberts' cylindrical sleeve *b* cannot do this. The very fact that it is cylindrical and is positioned about a cylindrical member makes this certain.

United States Patent to Eklind 1,576,317.

Eklind discloses a reinforcement for a wheel. In each case the reinforcement comprises an annular member corresponding in shape exactly to the wheel with which it is used. Figure 4 alone discloses a reinforcement which is not upon the surface of the wheel. Eklind speaks of his invention in the language beginning line 14 of page 1 as follows:

> "An object of this invention is to devise a simple and inexpensive method for reenforcing castings in the process of manufacture, *and particularly strengthening such parts of castings as are subjected in service to the greatest stresses*, to the end that objectionable strains and breakages in the castings during service are effectually prevented." (The italics are ours.)

The language above quoted, together with Eklind's disclosure, makes it clear that what he has done is to reinforce the castings where they are subject to the greatest stresses. Clearly Zingg has not done this. His device of Figures 5 and 6 is subjected to its greatest stresses in the direction of a line drawn horizontally from left to right through Figure 6. The inserts of Zingg are not intersected by such a line or a line drawn near it.

In the structures of Figures 8 and 9 of Zingg, the greatest stresses would occur along a line drawn vertically from top to bottom of Figure 8 or drawn axially or drawn vertically from top to bottom of Figure 9. Any of such lines passes through that portion of the insert 10 which is of the least thickness and hence of the least strength. Clearly Zingg is not in the manner of Eklind reinforcing that portion of his device subject to the greatest stresses. If there be any reinforcing effect in his device, and we submit there is not, that reinforcing effect is in the part of his casting subject to the least stresses. In Figure 4 of Eklind, although the reinforcing members are just under the surface of the casting, they are located generally to reinforce the points of greatest stress. Taking Eklind as a whole, it is clear that his structure comprises an exact example of a practice from which Zingg has departed.

United States Patent to Armstrong 1,718,210.

Armstrong is the third reference in which the reinforcings are annular or cylindrical and he provides one or more reinforcing cylindrical members which are cast within or cast upon the surface of a cylindrical member—a drill rod. His reinforcing cylinders have the form, end to end, of his drill rod and each of them is a complete cylinder. They can be nothing but reinforcements and they are placed in his device without any regard to a particular strain or stress and without any regard to the location which lines of force may follow. He certainly neither describes nor shows any means for changing the incidence or the direction of stress or strain. It cannot be said of his reinforcing members that they are intersecting" . . . lines of force in the casting and extending away from the area of maximum stress toward the areas of lesser stress."

The three other references which were relied upon and discussed by the defendant at the hearing before the Court below all disclose reinforcing members which are formed within a body of cast metal. These reinforcing members in Westlake and Trembour are of substantially rectangular cross section. In Canda they are of round or of rectangular cross section.

United States Patent to Westlake 980,719.

Westlake says, in the language beginning at line 21 of his first page: ". . . the object of these inserts being to strengthen the casting or to provide a metal having different physical properties from the metal which is cast around the insert." He is concerned primarily with abrasion resistance. This appears to be clear from language in his specification. After pointing out two types of uses, the first being for outside wearing surfaces, he says in the language beginning at line 25 of page 1:

> "Illustrations in the first class may be found in the inserts which are arranged in car wheels to strengthen them . . ."

He says that a second use is

> ". . . in the latter class in brake shoes where steel and cast iron are combined to offer wearing faces having different physical properties."

For his first use he is reinforcing a car wheel in the same general manner as that disclosed in Eklind. In the second he is providing an abrasion resistant surface generally like that provided by Roberts. He is not producing a structure which can alter or direct the stresses or strains or can alter the direction of the lines of force.

United States Patent to Canda 1,107,755 and United States Patent to Trembour 1,834,750.

Canda and Trembour may be considered together. They relate to jail or prison bars. To make prison bars resistant to filing and attack by other tools, they should be hard. Hard metal is generally brittle and if the bars were merely hard, they could be broken by impact. Hence Canda and Trembour combine a mass of relatively soft material in which reinforcements in the forms of rods or bars of relatively hard material are included. These reinforcements extend from end to end of each bar. Their position follows substantially the outline of a cross section through the composite bar. They have not been disposed to alter the direction of stresses or strains and could not do so. They are merely present to furnish hard members should the outer soft material be penetrated by a tool. There is no hint in either Canda or Trembour of the use or positioning of reinforcements for distributing stress or strain, and in fact, the reinforcements of these two patents could not accomplish that result.

Applicant's Diagram Discussed.

In the file wrapper history of the Zingg application, plaintiff appellants' Exhibit 1, there appears on page 33 a diagram illustrating three forms of beams. Figure 1 is an unloaded beam and unreinforced. Figure 2 is a loaded beam reinforced in the manner generally taught by the prior art and by the prior practice. Figure 3 illustrates a beam provided with an insert according to the invention of Zingg. At once it will be recognized that the insert of Figure 3 is small and extends throughout less than one-half the length of the beam.

In Figure 2 the reinforcement comprises one or more rods or bars embedded in the beam, which may be considered as being formed of cement. In a beam loaded as indicated in Figure 2, the point of greatest stress is the lower edge or the area near the lower edge, at which point the reinforcement is positioned. Correspondingly, the point of least stress is at or near the upper edge of the beam.

In the applicant's device, as shown in Figure 3, the insert 5 is positioned near the upper edge and centrally of the beam in the area of least stress or load, and it is definitely positioned away from the region of maximum stress. The insert 5 of Figure 3 has, therefore, the effect of causing the fibers of the beam which would ordinarily be subjected to the lower stresses to be subjected to greater stresses in consequence of the presence of an insert having a higher modulus of elasticity than that of the remainder of the beam. Since the presence of the insert 5 in Figure 3 causes an increase of stress at the point of minimum stresses, it correspondingly causes the hitherto maximum stressed areas to be relieved and in this manner some of the stresses of the maximum stressed parts or areas of the beam are transferred to the portions where the loading is less and where the stresses would be less in the standard beam of Figures 1 or 2.

The inclined line 1-2 shown in Figures 2′ and 3′ indicates the load distribution which is present in a homogeneous beam not provided with the inserts of the Zingg invention. As shown in Figure 2′, the curve 3-4 is the stress line characteristic of a beam having reinforcement such as that shown in Figure 2, and this curve 3-4 extends far beyond the original stress line 1-2 and produces an unsatisfactory result. By contrast to the condition illustrated in Figure 2′, attention is called to the condition illustrated in Figure 3′, which shows the stress conditions in a loaded beam embodying the insert 5 as illustrated in Figure 3. The member 6-7 is the stress curve, and it falls well within the maximum limit of the line 1-2 and hence shows that the presence of the insert has caused the maximum stressed fibers to be relieved and in this manner the stresses of the maximum stressed parts or areas or fibers of the beam are in part transmitted to areas of the beam where the load would otherwise have been less, and at no position in the beams can the stresses exceed the permissible maximum.

The diagrams just discussed illustrate not so much a particular embodiment of Zingg's invention as a general showing of the difference between the results of his invention and the results of the known prior art or prior practice.

The Defendant's Position.

The defendant's position, as stated by his counsel in his oral argument in the District Court, deserves some comment.

Mr. Cochran, defendant's counsel, in his argument said:

> "May it please Your Honor, whatever may be the theory on which Zingg's inserts operate, the fact is that what he has disclosed is the use of metallic inserts in a metallic body, the inserts having a different modulus of elasticity from the main body of the casting." (page 25, line 14, of the Appendix)

This statement is incomplete as a definition of Zingg's invention. Whatever the theory may be, Zingg does not merely provide metal inserts of a different modulus of elasticity from that of the main body of the casting. He does that and he does more than that, because he places the inserts in a definite position, and that position is specified in all of the claims involved herein. His inserts are placed, and the claims state that they are placed, to accomplish diversion and diffusion of the lines of force from the more highly stressed parts to the less highly stressed parts. Therefore, the mere statement of the difference of the modulus of elasticity does not give the whole picture.

Below the statement above quoted, Mr. Cochran makes the following statement:

> "As I say, whatever may be the theory of the operation of these inserts, that is what he has disclosed." (page 25, line 19, of the Appendix)

What was said with regard to the first quotation of Mr. Cochran may be repeated. The sentence last quoted does not give the *full* disclosure of Zingg.

Continuing further in his statement of the applicant's invention or disclosure, Mr. Cochran says:

> ". . . he states further that it may be of a higher modulus of elasticity than the body of the material, or even in some cases of a smaller modulus of elasticity." (page 25, line 23, of the Appendix)

Apparently the three above quotations indicate the understanding by the defendant of the applicant's total disclosure, because counsel goes on from that point to discuss the prior art in the following sentence:

> "Now, the art which has been cited here and discussed shows both of those things." (page 25, line 27, of the Appendix)

It is not disputed that the prior art discloses the use of a reinforcement in a metal casting in which the reinforcement is of a different modulus of elasticity from that of the main body of the casting. Appellants do not dispute this fact. The statements above quoted do not indicate the full Zingg invention, and the application of the prior art as indicated in the last quotation serves merely to show that something which Zingg is not claiming may have been old prior to Zingg's invention.

The defendant then quotes claim 12 in full and, commenting on Figure 6 of the Zingg drawings and upon the lines of force 3 shown in the drawings, says:

> ". . . it is not at all evident how those inserts could affect the concentration of lines of force in between the two inserts." (page 26, line 18, of the Appendix)

The inserts do not affect the lines of force which do not pass through them. Those are the lines of force extending in the direction of maximum stress, and while they might be affected by an ordinary reinforcement, they are not affected and are not intended to be affected by Zingg's inserts. As stated in the claims, it is the lines of force which extend ". . . away from the area of maximum stress toward areas of lesser stress'' which are affected by the insert.

The defendant further states:

> ''It is not at all clear how the placing of the inserts 5 at other places would draw away the force from that area. But in any event, the prior art shows many instances of the use of inserts in a casting wherein the inserts have a different elasticity than the casting.'' (page 26, line 22, of the Appendix)

Zingg has not said that his inserts draw away the force from the area of maximum stress, but has stated that his inserts intersect the lines of force extending from the area of maximum stress to that of lesser stress. Admittedly one side of the perforation in the casting 1 will have a maximum stress and lines of force which extend away from that area to an area of lesser stress are intersected by the inserts 5. The lines of force which extend along or within the area of maximum stress are not affected and are not intended to be affected by the inserts.

In his discussion of the Roberts reference, and commenting on the fact that the part *P* is a reinforcement which strengthens the crank, he says:

> ''Whether it does it by redistributing the lines of force is not so important, because it does have what plaintiff sets forth in his claims, namely, an insert having a different modulus of elasticity from the body of the casting.'' (page 26, line 31, of the Appendix)

This statement is in line with the reasoning applied by the Patent Office throughout the prosecution of the Zingg application and does not recognize the true nature of the Zingg invention. It is of vital importance whether a mere reinforcement is used which does not redistribute the lines of force, or an insert is used which does redistribute the lines of force. A mere difference in modulus of elasticity is not sufficient.

Zingg's effect is obvious from a comparison of Figures 4 and 6. The inserts 5 of Figure 6 comprise only a small fraction of the mass of the sleeve 4 of Figure 4, but they accomplish a greater degree of strengthening of the composite mass than that which is accomplished by the much larger sleeve 4.

In his discussion of the Westlake patent, Mr. Cochran says:

> "The plaintiff may have a different theory as to what happens, but the physical thing produced by the plaintiff and claimed by the plaintiff is no more than what is shown in the Westlake patent." (page 27, line 23, of the Appendix)

In our discussion above of the Westlake patent, we have pointed out the fact that his device is a mere reinforcement and that he gives no discluosure whatever of the location of his member 1 in relation to his lines of force or his areas of maximum or lesser stress. He definitely does not teach Zingg's solution, and the physical thing produced is not the same as Zingg's physical thing, because Westlake has not located his member 1 in any stated relation with regard to his stresses or his lines of force.

In a discussion of the Eklind patent, Mr. Cochran says:

> "In other words, you put the reenforcing member where it is needed." (page 28, line 6, of the Appendix)

This is merely a statement of a problem. Obviously any engineer in trying to design a structure which is to involve a reinforcement can be expected to put that reinforcement where he believes it to be needed. Zingg has discovered that the place where the insert is most needed is not the place in which the prior art has believed that the reinforcement should be located, and Eklind has merely used annular reinforcing members which, since they are concentric with the member which they reinforce, cannot have any effect in diverting or diffusing the stress or the lines of force. Zingg is not concerned with a theory except to explain a solution which is new. Even if he were incorrect in his theory, his structure differs from the structures of the prior art because in both forms of his invention the inserts are placed differently with regard to the stresses and strains and lines of force from the placing of the reinforcements of the prior art. Therefore, whatever Zingg's theory, his structure differs from the prior art and he does not rely upon his theory for his belief in the allowability of his claims.

What is essential in the practice of the Zingg invention is, first, that the user of the invention know where his maximum and minimum stresses and strains are, which of course is not shown in any of the art; and second, that he so locate his insert that he leads these stresses and strains into normally less stressed parts of the casting. Whether the insert performs of itself a reinforcing service or not is unimportant. None is called for by the claims.

As to the claims, the statement in claim 12 that the insert member intersects the lines of force in the casting and extends away from the area of maximum stress toward the areas of lesser stress, establishes the fact that there is a relationship between the location of that insert and the lines of maximum and minimum stress. Unless some patent shows that relationship and the importance of that relationship, and a member which will divert the strains from the maximum to the minimum areas of strain, then there can be no anticipation.

To go a step farther, the method claim 15 calls for a method of increasing the strength by positioning ". . . at least one metallic insert . . ."—which is not described as hard or soft—" . . . in such a position that it intersects the lines of force in the stressed casting, the modulii of elasticity of the body of the casting and the inserts being so related . . .''—whether greater or less makes no difference—'' . . . that the lines of force are diverted from the more highly stressed parts of the casting toward, and diffused in the less highly stressed parts thereof.''

That diversion and diffusion is absolutely not shown in the prior art, and if the best that the prior art can show is the well-known and ancient practice of reinforceing castings by reinforcements along the lines or in the areas of major stress, we submit the Zingg has at this late date in the metallurgical field shown surprising initiative and novelty.

Conclusion.

I. Zingg does not reinforce the areas of greatest stress in his composite article.

II. Zingg provides relatively small inserts to divert or spread the strain through areas of the main mass of material which would otherwise be less heavily loaded.

III. Many of the references show only surface reinforcing members conforming exactly in shape to the main member which they reinforce.

IV. Zingg does not use any surface reinforcing members.

V. The structures of all the references reinforce the areas of higher stress alone.

It is respectfully submitted that the appellant Zingg is entitled to his claims and that the decision of the District Court should be reversed and the claims allowed.

Respectfully submitted,

Norman S. Parker,
Leslie M. Parker,
Spencer B. Michael,
William A. Smith,
Attorneys for Ernst Zingg and
Sulzer Freres Societe Anonyme.

APPENDIX TO BRIEF FOR APPELLANTS

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

FILED NOV 30 1944

Joseph W. Stewart
CLERK

IN THE

United States Court of Appeals

District of Columbia.

No. 8859

ERNST ZINGG and SULZER FRERES, SOCIETE ANONYME, *Appellants,*

v.

CONWAY P. COE, Commissioner of Patents of the United States of America, *Appellee.*

Appeal from the District Court of the United States for the District of Columbia.

Spencer B. Michael,
Woodward Bldg.,
Washington, D. C.,
Attorney of Record.

Parker & Carter,
Of Counsel.

Press of Byron S. Adams, Washington, D. C.

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IN THE

United States Court of Appeals

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No. 8859.

ERNST ZINGG and SULZER FRERES, SOCIETE ANONYME, *Appellants,*

v.

CONWAY P. COE, Commissioner of Patents of the United States of America, *Appellee.*

Appeal from the District Court of the United States for the District of Columbia.

APPENDIX TO BRIEF FOR APPELLANTS.

I.

PLEADINGS, DOCKET ENTRIES AND OTHER PAPERS DESIGNATED.

1 Filed Apr 13 1943

In the United States District Court
For the District of Columbia.

Civil Action No. 19329

Ernst Zingg, Museumstrasse 8, Winterthur, Switzerland, and Sulzer Freres, Societe Anonyme, Winterthur Switzerland, *Plaintiffs,*

v.

Conway P. Coe, Commissioner of Patents, of the United States of America, Washington, D. C. *Defendant.*

Bill of Complaint to Compel Issuance of Patent

To the Honorable Chief Justice and Justices of the United States District Court for the District of Columbia:

Ernst Zingg and Sulzer Freres, Societe Anonyme, Plaintiffs, for their bill of complaint, allege:

1. That the plaintiff Ernst Zingg, is a citizen of the Republic of Switzerland, and whose post office address is Museumstrasse 8, Winterthur, Switzerland, and the plaintiff Sulzer Freres, Societe Anonyme, is a corporation of Switzerland, with their place of business at Winterthur, Switzerland, and bring this suit in their own right.

2. That the defendant, Conway P. Coe, during the occurrences herein narrated was and now is the duly appointed and acting Commissioner of Patents of the United States of America and as such Commissioner of Patents is domiciled within the District of Columbia of the United States, and is sued as such Commissioner of Patents.

2 3. This is a suit brought to authorize and compel the said Commissioner of Patents, as provided by

Section 4915 R. S. to issue a patent to Sulzer Freres, Societe Anonyme, as assignee of Ernst Zingg.

4. That on or about the 19th day of February, 1940, the plaintiff Ernst Zingg, being a citizen of the Republic of Switzerland, residing at Winterthur, Switzerland, and being within the meaning of the statutes then in force, the true, original, first and sole inventor of a new and useful improvement in Cast Metal Parts, which were not known or used in this country before his invention or discovery thereof and not patented or described in any printed publication in this or any foreign country before his invention or discovery thereof for more than two years prior to his application for Letters Patent therefor and not in public use or on sale in this country for more than two years prior to the filing of said application and not patented or caused to be patented in any foreign country on an application filed more than twelve months prior to the filing of said application in the United States and which has not been abandoned by him, duly filed in the United States patent office an application for Letters patent, together with the specification and claims thereof and the amendments made thereto, now on file in the said Patent Office as application Serial No. 319,597, will more fully appear and to which reference is hereby made the same as if incorporated herein, profert of which is hereby made by the plaintiffs.

5. That thereafter proceedings were had in the
3 Patent Office of the United States upon the said application and that on the 25th day of July, 1941, said application for patent having been more than twice rejected, was finally and wrongfully rejected on the merits by a primary examiner of the said United States Patent Office.

6. That on the 23rd day of January, 1942, in accordance with the statutes in such case made and provided, the plaintiff Ernst Zingg gave notice of appeal in the manner provided by law, from such decision of the said primary examiner of the said United States Patent Office, to the

Board of Appeals of the Patent Office of the United States, and duly paid the fee for such appeal.

7. That thereafter proceedings were had before the said Board of Appeals and a hearing on the said appeal was duly had and a decision thereon was rendered by the said Board of Appeals on the 15th day of October, 1942, affirming the decision of the said primary examiner and rejecting the plaintiff Ernst Zingg's application for a patent and particularly claims 12, 13, 14, 15, 16, a copy of which said rejection of the Board of Appeals is attached hereto marked "Exhibit A" and made a part hereof for greater certainty.

8. That the rejected claims aforesaid read as follows:

12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

4 13. A metallic casting having embedded in, completely enclosed by, and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

14. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress, the metallic insert having two surfaces integrally bonded to the casting, the lines of force intersecting both surfaces.

15. The method of increasing the strength of metal castings which consists in embedding therein in integral relation therewith at least one metallic insert in such a position

that it intersects the lines of force in the stressed casting, the moduli of elasticity of the body of the casting and of the insert being so related that the lines of force are diverted from the more highly stressed parts of the casting toward, and diffused in the less highly stressed parts thereof.

16. A metallic casting having regions of higher and regions of lower stresses, a reinforcing member embedded therein, completely enclosed by the body thereof having its entire superficial area integrally attached thereto and located in a region of lower stress, and having a modulus of elasticity greater than the modulus of elasticity of the body of the casting.

9. Plaintiffs further show that the said actions of rejection of the said primary examiner and of the said Board of Appeals are in fact the actions of the Commissioner of Patents, and constitute a refusal of the Commissioner of Patents to issue a patent to the plaintiffs on the said application therefor.

10. Plaintiffs further show that no appeal has been taken from the said decision of the said Board of Appeals to the United States Court of Customs and Patent Appeals.

11. That the action of the said primary examiner and the action of the Board of Appeals of the Patent Office and of the Commissioner of Patents, were wrongful and in violation of the rights of the Plaintiffs.

12. Wherefore plaintiffs pray that a writ of subpoena may be issued under the seal of this court directed to the above named defendant, Conway P. Coe, Commissioner of Patents of the United States of America, commanding him to appear and answer this bill of complaint, but not under oath, the answer under oath being hereby expressly waived; that this court adjudge that plaintiffs are entitled, according to law to receive a patent for the invention as specified in claims 12, 13, 14, 15 and 16 of the plaintiff Ernst Zingg's application therefor, or so many thereof as to this court may seem just; that said Commissioner of Patents shall be

compelled and authorized to issue a patent on the application so filed by the plaintiff Ernst Zingg, and that the plaintiffs may have such other and further relief in the premises as may appear proper and be agreeable to equity.

ERNST ZINGG, and
SULZER, FRERES, SOCIETE ANONYME
By NORMAN S. PARKER
PARKER & CARTER

8 South Michigan Avenue
Chicago, Illinois

SPENCER B. MICHAEL
Woodward Building, Washington, D. C.
Attorneys for Plaintiffs

6 Filed April 13, 1943

Exhibit "A"

Appeal No. 42,071
Hearing:
September 23, 1942

In the United States Patent Office

Before the Board of Appeals

Ex parte Ernst Zingg

Application for Patent filed February 19, 1940

Serial No. 319,597. Case Metal Parts.

Messrs Park & Carter for appellant.

This is an appeal form the action of the Primary Examiner finally rejecting claims 12 to 16, inclusive.

Claim 12 is illustrative and reads as follows:

12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus

of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

The references relied upon are:

Roberts	209,836	Nov. 12, 1878
Dow	1,296,373	Mar. 4, 1919
Armstrong	1,718,210	June 25, 1929

The rejected claims recite a metallic casting having embedded therein a second metallic member whose modulus of elasticity is different from the modulus of elasticity of the case metal. We believe that the examiner's rejection is warranted because the structure recited in the claims is substantially that stated above.

7 Furthermore, there is no question but that an inserted piece in the prior art intersects certain lines of force. The recitation of the position of the inserted piece as recited—extending away from the area of maximum stress toward areas of lesser stress—is quite likely true in the prior art constructions although there may be no statement to that effect in the patent specifications.

We note also, as did the examiner, that the question of having an insert of high modulus of elasticity is not important as it may be lower. In any event, the materials inserted in the references would have a different modulus of elasticity from the cast metal. We are not convinced that appellant's location of his inserted material would have any special effect in spreading the stresses but even aside from that, we think that the claims do not differ in terms from the prior art as discussed by the examiner. As far as structure is concerned, the claims involve introduction of a metal having a different character from the cast iron within the cast product.

The method claim is unwarranted as not defining a proper method. As far as the method is concerned, it merely involves inserting a metal of another character in an iron casting, which is obviously not patentable.

For reasons more fully discussed by the examiner, the decision of the examiner is affirmed.

BOARD OF APPEALS

W. L. REDROW
Examiner in Chief

E. T. MORGAN
Examiner in Chief

J. W. CLIFT
Examiner in Chief

October 15, 1942

PARKER & CARTER
8 S. Michigan Blvd.
Chicago, Ill.

* * * * * * * * * *

8 Filed May 14 1943

Answer to the Complaint.

To the Honorable the Justices of the District Court of the United States for the District of Columbia.

1, 2. Defendants admits the allegations of paragraphs 1 and 2.

3. He admits that the Court has jurisdiction under Section 4915 R. S. to authorize the issuance of a patent to Sulzer Freres, Societe Anonyme, assignee of the application of Ernst Zingg, Serial No. 319,597. He denies that Section 4915 R. S. gives the Court jurisdiction to compel the issuance of a patent by defendant.

4. He admits that on February 19, 1940, plaintiff Ernst Zingg, claiming to be the true, original, first and sole inventor of alleged new and useful improvement in Cast Metal Parts, filed in the Patent Office an application for patent thereon, to which application Serial No. 9 319,597 was given, and in said application made averments corresponding to the allegations of para-

graph 4. He denies that such allegations are sufficient to justify the issuance of a patent on said application.

5. He admits that on July 25, 1941, claims 12, 13, 14, 15 and 16 of said application, which claims are as set out in paragraph 8, were finally rejected by the primary examiner. He denies for reasons hereinafter given that said rejection was wrongful.

6, 7, 8, 9, 10. He admits the allegations of paragraphs 6, 7, 8, 9 and 10.

11. He denies that the actions of the primary examiner, the Board of Appeals and of defendant were wrongful in refusing a patent containing any of said claims 12, 13, 14, 15 and 16 of said application, or in violation of the rights of plaintiffs, as it is deemed that the said claims are unpatentable in view of the following prior patents and for the reasons given in the statement of the examiner in answer to the appeal and the decision of the Board of Appeals, copies of which will be furnished at the trial:

Roberts,	209,836,	Nov. 12, 1878,
Dow,	1,296,373,	Mar. 4, 1919,
Armstrong,	1,718,210,	June 25, 1929.

Profert of copies of these patents is hereby made.

W. W. COCHRAN
Solicitor, U. S. Patent Office,
Attorney for Defendant.

May 13, 1943.

I hereby certify that a copy of this Answer to the Complaint was mailed today, May 13, 1943, to the attorney for plaintiffs, Mr. Spencer B. Michael, Woodward Building, Washington, D. C.

W. W. COCHRAN
Solicitor.

* * * * * * * * * *

39 Filed Apr 28 1944

Memorandum.

Judgment for Defendant. Notify counsel.
April 28, 1944

DANIEL W. O'DONOGHUE
Justice.

* * * * * * * * * *

40 Filed Jun 5 - 1944

Findings of Fact.

1. This is an action under Section 4915 R. S. (U. S. C., title 35, section 63) in which plaintiffs seek to have the Court adjudge that they are lawfully entitled to receive a patent containing claims 12 to 16, inclusive, of the patent application of the plaintiff Ernst Zingg, Serial No. 319,597, which was filed in the Patent Office on February 19, 1940.

2. The application relates to a metallic casting in which there is embedded an insert member made of a metal whose modulus of elasticity is different from that of the metal of which the casting is made. The alleged purpose of providing the insert is to diffuse or spread the lines of force which exist in the casting when the same is subjected to a stress.

3. The patent to Roberts, No. 209,836, of November 12, 1878, discloses a casting in the shape of a crank. The crank pin there of is formed in part by a metallic member partially embedded in the body of the casting.

41 4. The patent to Armstrong, No. 1,718,210, of June 25, 1929, discloses a cast drill rod having embedded therein one or more tubular members made of a metal different from that of the casting.

5. The patent to Westlake, No. 980,719, of January 3, 1911, discloses a metallic casting in which there is cast a metallic insert having different physical properties from the metal of the casting.

6. The patent to Canda, No. 1,107,755, of August 18, 1914, and the patent to Trembour et al., No. 1,834,750, of December 1, 1931, disclose jail bars in the form of castings of comparatively soft metal. Within the body of the casting there are provided hard steel inserts.

7. The patent to Eklind, No. 1,576,317, of March 9, 1926, discloses a cast wheel having inserts or inlays of a metal which is tougher and more resistant to strain than the metal of the main body of the wheel.

8. In each of these patents the metal of the insert has a different modulus of elasticity from that of the metal forming the main body of the casting and in each of these patents the metallic insert is so disposed within the body of the casting as to intersect lines of force when the casting is subjected to stress in its normal use. The patents to Armstrong, Westlake, Canda, Trembour et al. disclose inserts which have their entire superficial area integrally attached to the metal of the casting.

9. Whatever effect plaintiffs' inserts may have in dispersing the lines of force in the casting, that effect
42 is also inherent in the patented structures.

10. None of the claims set out in the complaint defines anything amounting to invention over any one of the patents cited.

11. None of the claims set out in the complaint is patentable.

Conclusions of Law.

1. Plaintiffs are not entitled to receive a patent containing any one of claims 12 to 16, inclusive, of the application of plaintiff Zingg.

2. The complaint should be dismissed with costs against plaintiffs.

June 5th, 1944

DANIEL W. O'DONOGHUE
Justice.

* * * * * * * * * *

43 Filed Jun 5 1944

Judgment.

This action came on to to be heard at this term and thereupon consideration thereof, it is this 5th day of June, 1944,

Adjudged that the complaint be and it is hereby dismissed, with costs against the plaintiffs.

DANIEL W. O'DONOGHUE
Justice.

Approved as to Form:
SPENCER B MICHAEL
Attorney for Plaintiffs.

* * * * * * * * * *

II.

EXCERPTS FROM PROCEEDINGS DESIGNATED.

11 Mr. Smith: May it please the Court, the second case on your docket, Your Honor, is Civil Action 19329, the case of Ernst Zingg and Sulzer Brothers v. Conway P. Coe, Commissioner of Patents. Your Honor, the sole question involved in this case is the question of patentability of certain claims over references which have been cited by the Patent Office. As in the previous case, Your Honor, I should like to introduce Mr. Norman S. Parker and ask that he be permitted to argue this case specifically before your Court.

The Court: Very well.

Mr. Parker: If it please the Court, this is another case involving the same Swiss clients, Sulzer Brothers or Sulzer Freres, who are one of the leading engine manufacturers of the world and one of the largest industrial establishments in Switzerland. I mention that merely as background to indicate this is not a paper invention or something trivial.

We have been handicapped in this case, as in the other, by a failure to get mail through from Switzerland. We were told just about the time that direct mail was interrupted that Sulzer Brothers were sending us test data, affidavits and reports of tests and reports of use, so that we would have a pretty good record in this case. That material has not arrived, and I mention it as indicating the reason I am relying only on the Patent Office record as it stands.

I offer in evidence as Zingg Exhibit 1 the certified
12 copy of the file wrapper, and I understand that Counsel for Mr. Coe is putting in the seven references upon which he relies.

The Court: Plaintiffs' Exhibit 1, there being no objection, will be received in evidence.

(Certified copy of file wrapper was received in evidence and marked "Plaintiffs' Exhibit 1.")

The Court: Have you any other evidence for the Plaintiffs?

Mr. Parker: No other evidence, Your Honor.

The Court: Do you want to offer this Defendant's Exhibit No. 1 in evidence?

Mr. Cochran: Yes, Your Honor; and the contention of the defendant is that the claims in suit are not patentable over the patents set forth in this folder.

The Court: All right.

Mr. Cochran: I will ask the reporter to copy into the record the names of the patents; and there is also the Examiner's statement and statement of the Board of Appeals.

The Court: There being no objection, Defendant's Exhibit No. 1 will be received in evidence and the stenographer will take from the first page the different items listed in Defendant's Exhibit 1.

We will proceed with the argument.

(The file consisting of Roberts 209,836; Dow 1,296,373;
Armstrong 1,718,210; Westlake 980,719; Canda
13 1,107,755; Eklind 1,576,317; Trembour et al 1,834,750; Print of Drawings; Examiner's Statement; and Decision of the Board of Appeals; was received in evidence and marked "Defendant's Exhibit 1.")

Mr. Parker: I should like to mention the fact that of the seven references relied on by the Patent Office and by Attorney for Mr. Coe, four were new patents which we saw only a few days ago.

I should like to raise again the question of whether or not you care for a brief in this case. I judge you do not.

The Court: No, I would rather listen than read. I will decide this case as promptly as possible, within the next week, so I don't want to put you to the trouble of writing a brief and I likewise don't need the stenographic report. If you wish to have it written up, you may, but I won't need it.

Mr. Parker: You don't care for it?

The Court: No. If I should find I should be taken ill or had some urgent work to do and I couldn't get at these two cases within the next week or two, then I might ask you to let me have a brief or let me have the arguments; but there is no reason to put you to all that trouble when it won't be necessary for me to see a brief or read the arguments.

Mr. Parker: We will have the record ready to submit
if, in case of an emergency, it becomes necessary;
14 otherwise we will submit nothing.

The Court: I will let you know if I should want it. The only reason I would want it would be if, for some unforeseen reason, I shouldn't be able to get at it for several weeks.

Mr. Parker: I trust that nothing of that kind happens for your benefit, as well as for ours.

If it please the Court, this is a rather interesting case. The subject matter at least is interesting to me because the inventor has gone so directly contrary to established practice. The subject matter is a method of reënforcing—rather, I shouldn't say "reënforcing" because it isn't reënforcing; it is primarily a method of strengthening metal castings by employing inserts which operate, not because of their own strength, but which are employed to distribute stresses and strains in order to make metal of the casting work which under normal circumstances would be out of the main lines of force or lines of stress.

Of course, Your Honor knows what an engineer means by the term "lines of force." If you take a casting and you attach a part of it to one point and a part to another point and you move the casting or subject it to compression and tension, there are certain parts or areas which are more heavily loaded, more heavily strained, than others. Whether the strain is in compression or tension, whether it is compression or whether it is tension makes no difference. The point is, there tends to be a localization of strain, a localization of stress which creates fatigue and causes castings to fail. It is a constant problem in machinery and Sulzer Brothers as one of the leading engine manufacturers in the world, making Diesels and so forth, have had that problem to contend with for decades.

The obvious approach to strengthening a casting would be to put a reënforcement in that part of the casting where there is likely to be the greatest strain. That is obvious, and that is old, and that is shown admirably in some of the patents cited against Zingg. Zingg, instead of following that obvious procedure, developed the idea that since these lines of force are localized in the casting, you were in effect wasting a lot of the metal and that rather than put reënforcements where the maximum stress takes place, you should do something in order to make this loafing metal work.

If you will look at the drawings of the Zingg application, if you will look at Figs. 1, 2, 3, and 4, you will see what Zingg, in accordance with a not uncommon European practice, put in as the procedure from which he was departing. He described Figs. 1, 2, 3, 4, and 7 as illustrating what he didn't want to do. Figs. 5, 6, 8, and 9 are embodiments of his invention.

Referring first to Figs. 1 and 2, you have the example of a stud or bolt or member screw-threaded into a casting.
No treatment at all. It is simply screwed into a
16 tapped hole. Strains are localized. There is no
attempt, of course, to indicate the particular strain in this particular piece because the function of the piece does not of itself form part of the invention. It makes no difference. You could do this in a thousand different pieces, but the point is, if you put that screw in and then subject the combined member to tension or compression, you have no reënforcement; in the first place, you have no dispersal of strains and you have a tendency to localized strain and fatigue.

Now, the first step taken, as it was taken a long time ago, is to put a harder sleeve entirely around the inserted screw or bolt. That is shown in Figs. 3 and 4, not as an example of what Zingg does, but as an example of what Zingg finds it unnessary to do.

It is very significant that one of the patents relied upon by the Patent Office, namely, Roberts 209,836, surrounds a wearing part with a cylindrical sleeve. It is also significant that in Armstrong 1,718,210, for example Figs. 8, 9, 10, and 11, concentric reënforcing sleeves are employed which extend entirely about the article and presumably entirely about the major area of strain.

What Zingg elected to do was to take an insert having different characteristics of elasticity or hardness than the main body of the casting, and to put that insert in, not as
a reënforcement but as a means of making idle metal
17 in the casting work. For example, looking at Fig. 6
of Zingg, of the applicant, instead of the circumferential sleeve 4 which he departs from, he puts in two little inserts 5. These inserts extend through the area of maximum strain, and they do more than that; they extend from the area of maximum strain toward the area of minimum strain. They are banded, welded, to the rest of the casting so that there is no cleavage plane, and their effect, so Zingg

says, is to distribute that strain, to lead that strain into other areas of the casting.

Another example in Figs. 8 and 9, which should be compared with Fig. 7 from which Zingg departs, is to use an insert which carries out into the weak area. Most of the insert, you will observe, is in the area of lesser strain although it extends across the area of greater strain. Figs. 7, at 8, shows where the area of greater strain is. The normal, the obvious thing to do, the "prior art" thing, the procedure as taught by the patents relied upon by Mr. Coe, would be to put that reënforcement in the 8 area and employ it as a reënforcement, employ the reënforcment itself primarily to take a stress, to help.

The idea of carrying that insert which is not described in the patent as a reënforcement, the idea of using that insert as a means for distorting the stress lines, for fanning them out, is new with Zingg. The Patent Office found no
reference which even hints at any such procedure.
18 What the Patent Office did was to cite a substantial
number of patents, of which they finally relied on three, which showed the use of reënforcement in two main categories: in the first place, exterior reënforcement for providing a better wearing surface, and in the second place, interior reënforcement extending throughout the structure or throughout the area of strain for strengthening the reënforced body.

I should like to consider the three patents which the Patent Office finally relied on first. In the Robert patent 209,836, in the first column of the first page, the patentee mentioned that reënforcement of a crank pin of the type shown was known in the past by the use of a solid rod which was inserted in the mold at the position of the crankpin and incorporated with the casting. Roberts was speaking in 1878, so he is talking about a very venerable practice. He goes on to say, "But the cast metal of the pin is not protected thereby, nor is a good wearing surface obtained on the crankpin." Therefore, the subject matter of the

Roberts invention was the protection of the exterior surface of the crankpin, which of course might take a flyrod or some other moving part in a regular wearing relationship. That wearing relationship could be more advantageously handled by a hardened outer sheath than by an inner reënforcement or no reënforcement.

Obviously, if you are going to use a hardened outer
sheath for a wrist pin, crankpin, the ends of that
19 sheath have got to project into the crank structure
as they do in Roberts, and Roberts employs flanges
to inter-penetrate with the metal and make a tight joint. There is no suggestion in Roberts of any attempt to distribute the stresses throughout the members C or D of his Figs. 1 and 2. There is no hint in Roberts of any advantage in strain distribution. There is no discussion in Roberts of where the strains run, but what he is talking about is a general strengthening to resist shocks or torsion which at the same time will afford a superior wearing surface; and that is what anyone who read that patent cold, without knowing of our Zingg invention, would get out of it. He would be directed to use a hard shell around a crankpin, and he wouldn't be directed to do anything else.

Dow is the second reference, 1,296,373.

Mr. Cockran: If it will shorten the proceedings, we will not rely on that patent.

Mr. Parker: We will pass up Dow. I couldn't understand why Dow was cited; I never could.

The next patent, then, is Armstrong 1,718,210, filed in 1922, more than twenty years ago. Armstrong describes and shows a process of making hollow drill rods. He shows various forms of drill rods and he discusses the use of reënforces and reënforcements in such drill rods. He mentions tremendous vibratory stresses, although he doesn't
say where in the rod they take place. He describes
20 his invention as applied to axles and steam hammer
shafts; and then on the first page, the first column,
third paragraph, when he begins to discuss his invention

in detail he says that, according to his invention, "a rock drill is provided with a tough reënforce, for example a reënforce of low carbon steel or other tough material, which serves to prevent breakage without substantial loss of cutting power." In other words, from the beginning and right through his patent, he is describing a detailed application of this well known art of reënforcing materials which are subjected to stress and strain.

How does he reënforce it? In Figs. 4, 5, 6, and 7 he shows different kinds of reënforcing members which can be inserted in his drill rod, you will observe, so that as far as they are shown in detail they are without exception cylinders. He shows them applied in Figs. 8, 9, 10, and 11. Without exception, they are cylinders concentric with the central axis of the rod. He shows the mode of pouring the rod in Figs. 12 and 13, and there he shows that these reënforces or cylinders extend from end to end of the drilled rods. In other words, if you assume that a drill rod is to be subjected to bend, flexure, you will have a reënforcement or a series of reënforcements extending from end to end of that rod throughout the rod, without regard to where the maximum strain takes place. They are reënforcements.
They strengthen the whole structure. They extend
21 from end to end of the structure. They extend
throughout the structure. That is the known and obvious procedure of reënforcing a member which is likely to be subjected to strain, without regard to where the particular strain will take place and without any attempt to use an insert as a means for changing the incidence of strain or stress.

Those two patents, and the Dow patent which I did not mention, were the only patents which the Patent Office finally relied on.

It was always hard for me to understand why these claims were turned down, but now that we have a little background on the art, I should like to read the rejected claims. Consider Claim 15, the method of increasing the strength of metal castings ''which consists in embedding therein, in integral relation therewith, at least one metal insert''—not reënforcement but insert—''in such a position that it intersects the lines of force in the stressed casting, the moduli of elasticity of the body and of the casting of the insert being so related''—it may be greater or it may be less; the insert may be harder, it may be softer—''that the lines of force are diverted from the more highly stressed parts of the casting toward and diffused in the less highly stressed parts thereof.''

In other words, the procedure which Zingg thought he had invented was a departure from the conventional re-
ënforcement such as is shown in that drill rod I have
22 shown you to a method and application in which the
insert, instead of being a reënforcement, instead of operating like a reënforcing bar, is a diverting member which diverts or patterns the lines of stress and strain to which that casting is subjected.

As Zingg points out in his specification, the inserts may be harder or they may not be. They may be entirely enclosed in the body or they need not be. The point is that they are used for a particular result which is not mere reënforcement, which is not mere surface protection. As I said before, it is to make the loafing metal work and therefore relieve the stress of the overworked metal by drawing the unworked metal into the pattern.

Another claim which is typical of the apparatus claims is Claim 12: "A metallic casting having embedded in and integrally attached thereto a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.''

You notice that the term ''reënforcement'' is not employed and that the member within the terms of that claim, and as pointed out in the specification, need not be harder or more resistent than the casting.

Very shortly before the trial, we received notice
23 that some additional art would be relied on, and that
art interested me because it seemed to indicate that
the theory, the conception of Zingg, was entirely misunderstood; otherwise these patents would not have been cited.

I should like to consider first Eklind 1,576,317. The Eklind patent is for a method of forming reënforced castings. There is your word "reënforced." All of the figures except Fig. 4 show a reënforcement in which a harder exterior surface is applied to or associated with the body of the casting. In Fig. 1, which shows a car wheel in a hold, with the chill present, you will see at 12, indicated at the lower right of Fig. 1, two exterior members which conform to the exterior surfaces of each side of the car wheel, one running up to the root of the flange, and the other running almost to the wearing surface.

Now, why were those put in there? Eklind says: "An object of this invention is to devise a simple and inexpensive method for reënforcing castings in the process of manufacture"—reënforcing—"and particularly strengthening such parts of castings as are subjected in service to the greatest stresses, to the end that objectionable strains and breakages in the casting during service are effectively prevented."

In other words, you put in an element which you call a
reënforcement, to do a reënforcing job at the area of
24 greatest strain, which of course is along the sides
of the car wheel.

The only example of an insert which is entirely enclosed is shown in Fig. 4 of Eklind; and where are those inserts put? They are put just inside the surface and they are put, with that difference, just where the inserts 12, the surface layers 12, are employed. In other words, one of them runs up into the root of the flange, which of course is the hardest wearing part of a wheel, and the other runs up toward the inner toe, you might say, of the working surface, which is another place where car wheels wear, and I don't believe that anything is necessary on the record to know that that is where car wheels wear because if you ever watched cars go by and watched them in the switchyards and watched them in the stations, you have frequently seen the wear, especially on freight cars, at those points. Therefore, Eklind is an admirable example of precisely what Zingg is departing from.

Another reference of this new tribe is Westlake 980,719. Westlake mentions that the use of inserts in molds is old, as it is, and when Westlake filed back in 1910, almost thirty-five years ago, he mentions that inserts had been arranged in the matrices of molds around which the molten metal has been poured, ''the object of these inserts being to strengthen the casting or to provide a metal having different physical properties from the metal which is cast around the insert.''

Then for examples, what does he give? Two types: First, outside wearing surfaces. He says, ''Illustrations in the first class may be found in the inserts which are arranged in car wheels to strengthen them''—in other words, just such an insert as we saw in Eklind. And second, ''In the latter class, in brake shoes where steel and cast iron are combined to cover wearing faces having different physical properties.''

There is no specific example of the use of an insert in this patent outside of that, and what Westlake is working in is the art of casting, and his contribution to the art of casting is a particular proportion of iron and manganese for an insert. No one reading this casting patent from an entirely non-analogous art would be directed in Zingg's direction, and if you assume that it is analogous (and I am willing that it should be assumed), certainly there is no hint in Westlake of the use of an insert for distributing or altering stress and for making the weaker part of a casting help in the work of a stronger part.

Two more patents were cited which can be considered together because they relate to a very specialized and interesting art, the ancient art of producing composite bars for prisons. Consider the earliest first, Canda 1,107,755, which was filed in February of 1907, not far from forty years ago.

Canda was teaching the employment in a jail bar of
26 separate metal components which perform separate
functions. A jail bar normally takes no stress or strain at all. It is simply in a window or cell. But it may be subjected to sudden stresses as the result of an attempt by a criminal to get out; and the first and most obvious method, which involves less noise although more time, is a saw. If you have a soft bar, it is easily sawn.

Another method is to break it, smash it with a club, a sledge. Soft metal resists that type of shock better than had metal. Hard metal tends to splinter and crack. Therefore, since at some possible time every cell rod may be subjected to one or another of these attacks, it has for a long time been customary, as is shown by the antiquity of the Canda patent, to employ cell rods in which a body of relatively soft metal protects inserts of relatively hard metal which extend from end to end of the bar. Therefore, if a criminal tries to saw through a bar, his saw strikes very rapidly the hard inserts which are intentionally put near the surface and he can't saw very far. On the other hand, both the exterior layer of the soft metal and the interior metal protect the harder components of the rod from breakage.

There is no hint anywhere in this patent of the employment of inserts for distributing stress or strain. It is significant that every one of these reënforcing inserts
must extend from end to end of the rod, because that
27 is the way the rod is made, as is clear from Fig. 1.

It is clear from Fig. 5, Fig. 6, Fig. 7, that these reënforcements extend all the way around the rod. If you subject a rod to flexure, your maximum strain will be at the point where the flexure is applied and you will get a compression stress on one side of the rod and a tension stress of the other, and the tension stress, which is the side opposite the side of thrust, may be the most dangerous and the higest. In other words, there is a difference of stress. However, it is obvious from the use of this device that no one can tell from which side or from what point the maximum stress is to be subjected. Therefore, it would be idle to look in a jail bar patent for any attempt to tell where the maximum stress will take place, or to provide means for canalizing or modifying the stress from the maximum to the minimum.

The other patent in the same field is Trembour 1,834,750. This Trembour patent is simply a later modification of the same type of structure. It has a body of soft metal with a series of harder reënforcements which extend from end to end of the rod, and Trembour thus describes his invention: "Thus jail bar steel is characterized by a body of relatively soft steel which cannot be readily shattered or broken, and inserts of relatively hard steel which cannot be readily cut." His invention, in other words, is in an
old art, and he shows a little different pattern, a
28 little different way of making this steel bar, but his
end result is a bar with these strengthening reënforcements of hard material extending from end to end.

In the file wrapper history which I offered, there is a diagram at page 33 which I wish you would look at. That diagram was sent from Switzerland and it is the last thing we got before this case went to appeal, and it shows in Fig. 1 an unloaded beam with the stresses extending theoretically from end to end. If your procedure is to reënforce that whole beam, you might fill the beam with a large reënforcing element as shown in Fig. 2, or you might fill that beam with a series of reënforcements extending from end to end throughout the beam; or you can do what Zingg does and teaches in Fig. 3; He puts in an insert which is not a reënforcement, which need not go from end to end of the bar, and which need not be completely in the zone of maximum stress or strain. It extends from an area of greater strain to an area of lesser strain, and it puts the rest of the bar to work.

Sometimes there is a great saving in metal involved, sometimes not, but the informing idea is directly contrary to and departs from the informing idea of putting a reënforcement along the major line of stress or concentrating your reënforcement where the greatest work is being done and employing a reënforcement as a sort of "shotgun" proposition to cover all of the area where there may be some strain.

29 Zingg represents a new procedure, one which is not taught by a reading of any of the patents cited, and I submit, Your Honor, that Zingg has made an invention of great value and one which is absolutely not shown in the cited art.

Mr. Cochran: May it please Your Honor, whatever may be the theory on which Zingg's inserts operate, the fact is that what he has disclosed is the use of metallic inserts in a metallic body, the inserts having a different modulus of elasticity from the main body of the casting.

As I say, whatever may be the theory of the operation of these inserts, that is what he has disclosed. He states in his specification that the piece which he inserts may be either entirely within the body of the casting or may be partially on the outside, and he states further that it may be of a higher modulus of elasticity than the body of the material, or even in some cases of a smaller modulus of elasticity.

Now, the art which has been cited here and discussed shows both of those things. Some of the art shows inserts of higher modulus of elasticity and some of a lower modulus of elasticity. If we take the patents cited and compare them with the claim, first let's consider Claim 12 which calls for "a metallic casting having embedded in and integrally attached thereto a metallic insert member whose modulus of elasticity is different from the modulus of elas-
30 ticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress."

If we look at the drawing of plaintiffs' application, we see in Figs. 2, 3, and 4 that there are some little lines which are supposed to indicate, I suppose, the concentration of force. Similar lines are shown in Fig. 7. It is obvious that those lines of force and the location thereof are not properties or characteristics of the piece of metal itself, but of the use of the metal. The lines would be in a different place if the piece of metal were subject to a different stress or strain; so the location of the lines is not a characteristic of the casting, although in the ordinary use of the casting no doubt the lines would be located in a particular region.

But now if we look at Fig. 6 as compared to Fig. 2, that is supposed to represent what would happen to the lines of force when the inserts 5 were put into the casting. While no doubt the inserts 5 would have some effect on the lines of force which previously had gone through the region where they are located, it is not at all evident how those inserts could affect the concentration of lines of force in between the two inserts. In other words, in Fig. 2 the lines of force are shown as most heavily concentrated at about the middle point. It is not at all clear how the
31 placing of the inserts 5 at other places would draw away the force from that area. But in any event, the prior art shows many instances of the use of inserts in a casting wherein the inserts have a different elasticity than the casting.

If we take the Roberts patent, which is the first one, we find that it says that the part "P" is a metallic reënforce and it is made preferably of steel or wrought iron, and it is put there to strengthen the crank. Whether it does it by redistributing the lines of force is not so important, because it does have what plaintiff sets forth in his claims, namely, an insert having a different modulus of elasticity from the body of the casting.

If we turn to the Armstrong patent, which is Part C of Defendant's Exhibit 1, we find in Figs. 9, 10 and 11, three separate instances of reënforcement. In Fig. 9 the cylindrical sheet 14-A out on the outside is the reënforcement. In Fig. 10 there is a 14-I which is located within the body of the drill rod; and in Fig. 11 we have an instance of two separate reënforcing sleeves or rings which are locally embedded within the drill rod. The specification says on page 1, "According to my invention, the hard steel of the rock drill is provided with a tough reënforce, as for example a reënforce of low carbon steel." In another place, on page 3 of the patent, it is said that "a reënforcing tube of nickel, for example, may give good results."

32 Inasmuch as these reënforcing members are incorporated in the casting operation, they are naturally intimately connected, the same as by welding. That is the same manner in which plaintiff puts his parts together.

In the Westlake patent, which is part D of Defendant's Exhibit 1, there is shown an insert member 1 which is said in the patent "to be molded into the casting 2, the object being to strengthen the casting or to provide a metal having different physical properties from the metal which is cast around the insert." That, I submit, is just exactly what the plaintiff has here. The plaintiff may have a different theory as to what happens, but the physical thing produced by the plaintiff and claimed by the plaintiff is no more than what is shown in the Westlake patent.

Westlake proceeds to say that, "If the insert 1 is used as a reënforcing or strengthening medium or for any other purpose, on account of its physical properties it responds fully at all times to the requirements exacted of it."

As to the two jail bar patents, we need not dwell long on them. Each, as plaintiff's Counsel pointed out, discloses a main body composed of relatively soft material reënforced by hard bars molded in. That is the case where you put a harder metal inside the softer one.

The patent to Eklind is a good example of what has been done in the prior art. That is the brake wheel which has in

33 Fig. 4 two reënforcements molded within the wheel. He states that "An object of this invention is to devise a simple and inexpensive method for reënforcing castings in the process of manufacture, and particularly strengthening such parts of castings as are subjected in sevice to the greatest stresses." In other words, you put the reënforcing member where it is needed. In some cases the reënforcement is on the outside as shown on Fig. 1, but on Fig. 4 it is entirely included within the body of the wheel.

He states that "the reënforcing inserts or inlays are of material tougher than the main body of the casting." That is in column 1 of page 1 of the patent. I submit then, if Your Honor please, that whatever is claimed here physically is in the prior art, that all the plaintiff has to rely on is some different theory of operation which, if it exists in his device, is inherent in these.

Mr. Parker: If it please the Court, I won't take long. I take Mr. Cochran's statement to be an admission that the entire operative theory of Zingg is new and is different from the operative theory of any of the references found by the Patent Office. In this, I heartily agree with him. The question, then, is whether or not the characteristics of Zingg are inherent and whether or not they are brought out in the claims.

Since the entire orientation of Zingg's application
34 and his claims is the dispersal of stress and not reënforcement, the invention is not inherent in patents which emphasize reënforcement and say nothing of dispersal of stress.

Mr. Cochran has presented no evidence, and the Patent Office had none, as to where the maximum stress and strain came in these various structures. There is no example in any of these structures of positioning an insert in order to lead these strains into normally less strained parts. Zingg is not patenting a reënforcing method. He does not show a reënforcing method. He does not use a reënforcement.

His insert may be softer than the surrounding body, as Mr. Cochran admitted.

What is essential is in the practice of this invention: first, that the user of the invention know where his maximum and minimum stresses and strains are, which of course is not shown in any of the art; and second, that he so locate his insert that he lets these stresses and strains into normally less stressed parts of the casting. Whether the insert performs of itself a reënforcing service or not is unimportant. None is called for by the claims.

As to the claims which I think Mr. Cochran disposed of rather cavalierly, the specification in Claim 12 that the insert member intersects the lines of force in the casting and extends away from the area of maximum stress toward the areas of lesser stress, there is a relationship between the location of that insert and the lines of maximum and minimum stresses. Unless some patent shows that relationship and the importance of that relationship, and a member which will divert the strains from the maximum to the minimum areas of strain, then there can be no anticipation.

To go a step farther, in the method claim, Claim 15, it calls for a method of increasing the strength "by positioning at least one metal insert"—which is not described as hard or soft—"in such a position that it intersects the lines of force in the stressed casting, the moduli of elasticity of the body of the casting and the inserts being so related" —whether greater or less makes no difference—"that the lines of force are diverted from the more highly stressed part of the casting toward and diffused in the less highly stressed parts."

That diversion and diffusion is absolutely not shown in the prior art, and if the best that the Patent Office was able to point to was the well known and ancient practice of reënforcing castings by reënforcements along the lines or in the areas of major stress, I submit that Zingg has in this late date in the metallurgical field shown surprising initiative and novelty. Thank you.

The Court: I will take the case under advisement and the Clerk will notify you of the decision of the Court.

* * * * * * * * * *

III.

EXHIBITS.

Excerpts from Plaintiffs' Exhibit No. 1.

51 *Specification.*

To all whom it may concern:

Be it known that I , Ernst Zingg, a citizen of Switzerland residing at Winterthur, Switzerland have invented certain new and useful improvements in Cast Metal Parts of which the following is a specification:

52 This invention relates to cast metal parts and a method of making such parts with the lines of force therein more uniformly distributed than heretofore.

It has been proposed to insert pieces of tougher metal at highly stressed spots in parts constructed by casting or pressing, in order to prevent deformation or damage at such highly stressed spots. For example, when casting light-metal cylinders valve-seat rings of harder metal have been cast in at the same time, or when making parts of plastic material metal pieces have been pressed into them so as to take screwthreads. In these cases a softer material is replaced by a harder one at a place particularly highly stressed by external forces. The distribution of the lines of force, however, remained unchanged, being still crowded together at the highly stressed places.

Further, in light-metal pistons, rings of tough metal have been inserted in order to prevent deformation in consequence of expansion due to heat, but in these no attention was paid as to how the lines of force ran and their directions were not affected by the inserted parts.

In reinforced concrete, iron reinforced concrete, iron reinforcement is inserted at the most highly stressed spots in order to take the tensile forces. Between the iron re-

inforcements and the concrete there is no real adhesion through the construction, but the forces are transmitted through the bent-back ends of the reinforcing members. For this reason no change can take place in the run of the lines of force; in fact it is rather the case that all the tensile forces are transmitted through the reinforcement
and only the compression forces are taken by the
53 concrete. Compression or bending stresses cannot
be taken by the reinforcement.

The process according to the invention consists in that at least one shaped metal piece, whose modulus of elasticity differs from the modulus of elasticity of the metal to be cast, is inserted into the pattern of the part to be cast and incorporated with that part by the casting operation, thus diverting the lines of force from highly loaded spots to less loaded spots.

In the construction of parts according to this invention less tough materials are not merely replaced at highly stressed positions by tougher or harder materials, but the purpose of the invention is rather to divert the crowded lines of force towards less highly stressed positions, so that the total force is more evenly distributed over the cross-section of the constructed parts. This uniform distribution of the stresses is partly to be attributed to the fact that between the cast metal of which the part is formed and the metal of the inserted shaped piece there is such a connection owing to the fusing together of the metals that any shearing stresses can be fully transmitted between the two metals. The shaped metal parts can then be submitted to tension as well as to compression and bending stresses. It is possible to make the inserted pieces of such a shape that the lines of force are distributed practically uniformly over a large cross-sectional area thus increasing the fatigue strength of the whole part.

Particularly in the case of metals that melt at low temperature the inserted piece may be connected to the main part during the casting operation by means of some known

welding process. For example, for this purpose the
54 shaped piece may be dipped into liquid magnesium
before being cast into the constructed part, so that when casting takes place a welding together of the liquid metal with the shaped piece is encouraged. The shaped piece may be situated either entirely within the cross-section of the cast part or it may lie partially on the surface. The shaped piece may be itself formed by casting, forging, extrusions or stamping.

The accompanying drawings illustrate the invention. In these drawings—

Figures 1 to 4 show hitherto known constructions,

Figures 5 and 6 show an example of a similar construction but according to the present invention,

Figure 7 represents a further known construction, and

Figures 8 and 9 show the same construction but as carried out according to the present invention.

Referring to Figures 1 and 2 the part 1 is to be connected to some other part by means of a bolt 2. Tensile or compression stresses will consequently be exerted on the flange through the bolt 2. According to the shape of the part 1 the lines of force 3 are crowded together in a central region, whilst at both sides the stress in the material is considerably lower. The high stresses in the middle may lead to early failure of the part, particularly if the stresses are alternating.

In the case of parts formed by casting or pressing it has already been proposed to insert bushes 4, as shown in Figures 3 and 4, made of a harder or tougher metal in order to prevent too early a destruction of the material, at least in the region of the screwthreaded surface.
55 The directions of the lines of force, however, are
not changed, since the elastic distribution of the material remains unchanged.

According to the invention two shaped pieces 5, as shown in Figures 5 and 6, made of a material with a higher modulus of elasticity are cast into the part 1. By reason of the nature of the material chosen for each shaped piece, the shape given to it, and also the manner in which it is arranged in the pattern of the part to be cast, the lines of force 3 are no longer so crowded together in the centre, but are distributed more uniformly over a greater area. Too early a failure of the piece will therefore tend to be prevented since the maximum stressing per unit area is reduced.

Figure 7 shows one web of a well-known type of cast-iron crankshaft in which a crankpin 6 is connected to the shaft 7. In the shape normally given to the crank-web, the lines of force crowd together in the middle at the place 8. The outer parts 9 of the crank-web, which are not so stiff, are much less loaded. Referring to Figures 8 and 9, if a shaped piece 10, or several separate shaped pieces of the correct form and of a higher modulus of elasticity are cast into the crank-web, the lines of force will no longer be so crowded together but they will be more uniformly distributed over a larger cross-sectional area. The outer parts 9 will be utilised to a greater extent to transmit the forces, and the middle part will consequently not be so subject to the risk of premature failure.

The shaped pieces may be constructed of cast steel or other metal. It is also possible to forge the shaped pieces in dies or by some other method or they may be
56 formed by hot stamping. In the case of metals that
melt at a high temperature the shaped pieces may be inserted direct into the pattern of the part to be constructed, when as a result of the high temperature of the metal to be poured a connection is formed internally through the melting together of the parts. It is preferable to clean the shaped pieces thoroughly before inserting them into the pattern, and particularly to remove from them any layer of oxide. Should the pouring temperature not be sufficiently high to ensure a connection by fusing together of the metals, the shaped piece may be specially prepared beforehand, for example by dipping it into liquid

magnesium, thus making it suitable for treatment by some known form of welding. While the metal is being poured an inner connection will then be formed by the welding together of the main part and the shaped piece. The shaped pieces must be adapted to the particular requirements with regard to the loading and stressing of the part to be constructed. In some cases instead of having a higher modulus the inserted pieces may have a lower modulus of elasticity than the metal of the part to be cast. These pieces must then not only be suitably shaped but also inserted in other zones.

* * * * * * * * * *

#2

#2

Fig. 1.

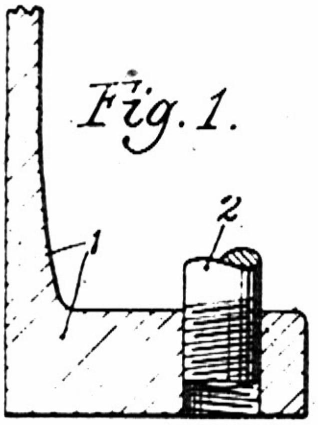


Fig. 3.

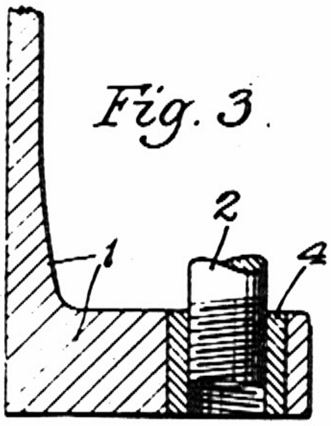


Fig. 5.

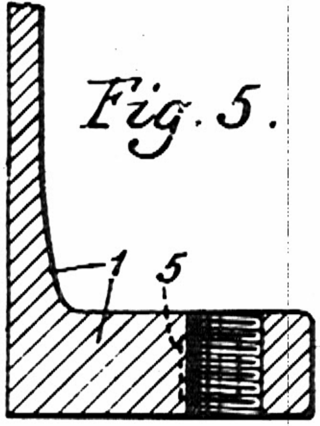


Fig. 2.

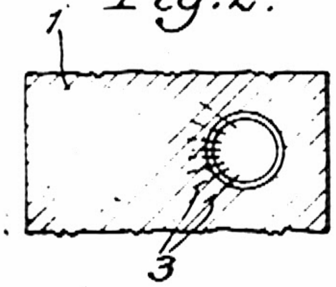


Fig. 4.

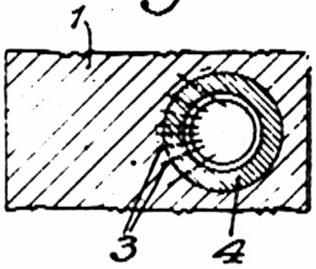


Fig. 6

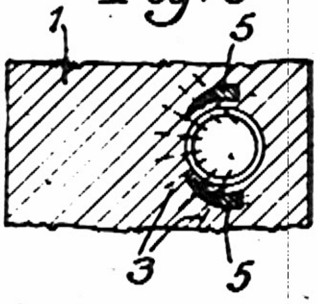


Fig. 7.

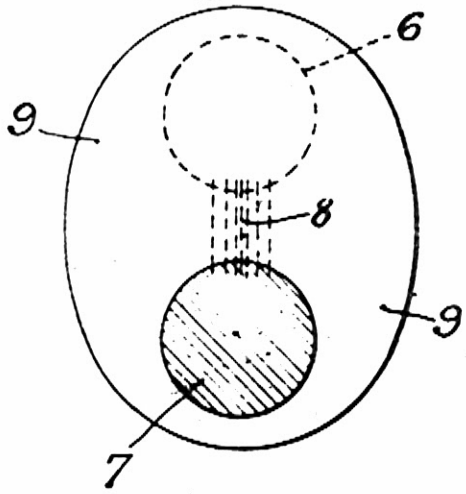


Fig. 8.

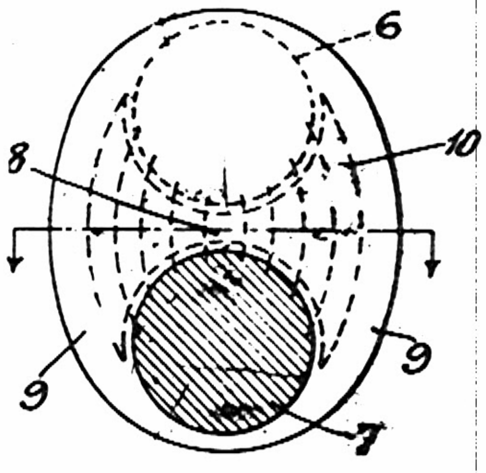
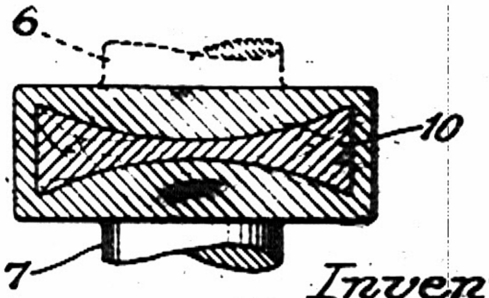


Fig. 9.



Inventor
Ernst Zingg.
by Parker & Carter
Attorneys.

Fig. 1 Unloaded beam

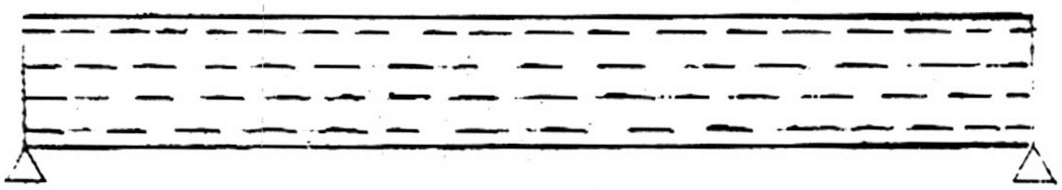


Fig. 2 Old reinforcement member

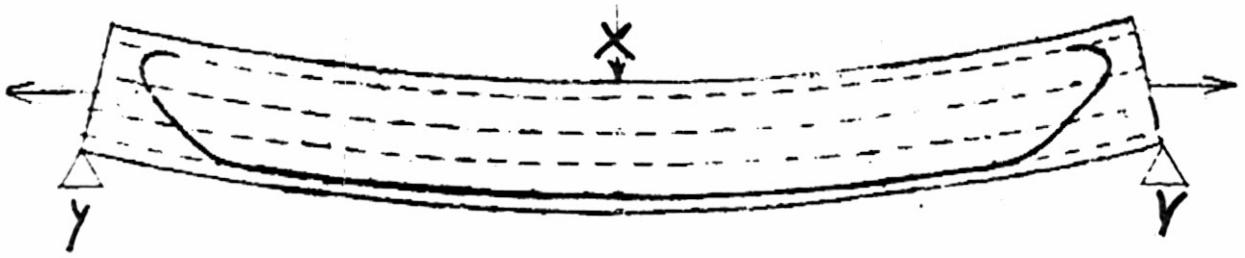


Fig2'

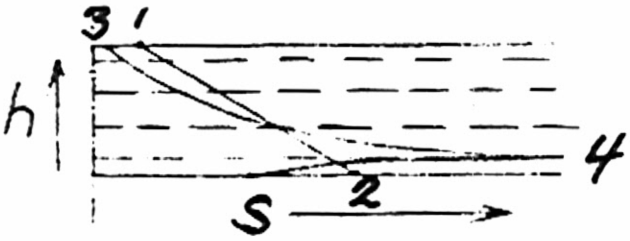


Fig. 3 Insert member according to the invention

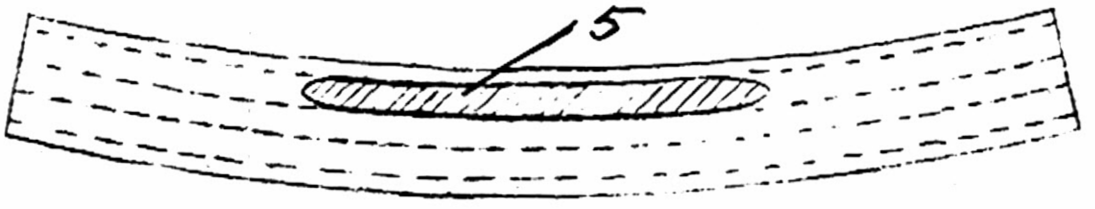
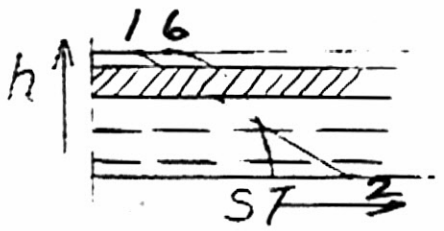


Fig3'



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Div. 3 Room 412 E:mb Paper No. 13

Department of Commerce
United States Patent Office

Before the Board of Appeals

In re application of Ernst Zingg
Serial No. 319,597
Filed Feb. 19, 1940
For. Cast Metal Parts

Examiner's Statement.

This is an appeal from the final rejection of claims 12, 13, 14, and 15. Claim 16 has been entered for the purpose of appeal, and is also rejected. No claims have been noted as allowable.

The claims under rejection are:

12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

13. A metallic casting having embedded in, completely enclosed by, and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

14. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress, the metallic

insert having two surfaces integrally bonded to the casting, the lines of force intersecting both surfaces.

90 15. The method of increasing the strength of metal castings which consists in embedding therein in integral relation therewith at least one metallic insert in such a position that it intersects the lines of force in the stressed casting, the modulii of elasticity of the body of the casting and of the insert being so related that the lines of force are diverted from the more highly stressed parts of the casting toward, and diffused in the less highly stressed parts thereof.

References:

Dow, 1,296,373.
Armstrong, 1,718,210.
Roberts, 209,836.

Grounds of Rejection:

Claims 12, 13, and 15 are under rejection as unpatentable over each of Roberts, Armstrong, and Dow.

Claim 14 is under rejection as unpatentable over Armstrong.

Claim 16 is rejected in the same way as claims 12, 13, and 15.

Description of Alleged Invention:

The alleged invention relates to a method of making strong castings. The method involves the use of metallic inserts incorporated in the casting at certain areas. It is the place of the inserts which constitutes the alleged novelty.

Applicant states that there are certain zones in a casting, which contain a greater concentration of stresses, during use, than other zones. Applicant's object is to more evenly distribute these stresses, or lines of force. Applicant proposes to accomplish this by placing inserts in the casting at those zones which are at lower concentration of stresses.

Applicant illustrates his alleged invention by illustrating
the lines of force in two kinds of castings, comparing
91 a casting made according to the old art and those
according to his proposal.

Figures 1 to 4 and 7 show castings of the prior art type. Figures 5, 6, 8, and 9 show castings according to applicant's proposal. Figures 1 to 4 are to be contrasted with Figures 5 and 6, while Figure 7 is to be contrasted with Figures 8 and 9.

In Figures 1 and 2, showing a member 1 provided with a bolt 2 to connect 1 with some other member, the lines of force are shown by lines 3. In Figures 3 and 4, which show another embodiment of the prior art, the member 1 is provided with a harder metal bushing 4, the lines of force being again shown by lines 3. It is noted that the lines of force shown in Figure 2 are more concentrated in one zone, and that in Figure 4 the same condition obtains. In Figures 5 and 6, which show one of applicant's embodiments the inserts 5 are placed in zones, where normally there would be less lines of force (according to applicant's illustrations in Figures 2 and 4.) The lines of force in Figure 6 are shown to be uniformly distributed.

In figure 7 a crankshaft construction, according to the prior art, has a crank pin 6 connected to the shaft 7 by a web 9, and the lines of force are shown as concentrated at the middle, 8. Figures 8 and 9 show such a crankshaft, embodying applicant's proposal, wherein an insert 10 is placed in the web 9, and the lines of force are now uniformly spread out.

In the two examples of his embodiments, the inserts are of higher modulus of elasticity than the metal of the cast-
ing. The specification states, however, that in some
92 cases the inserts may be of lower modulus of elas-
ticity (page 5, lines 18 to 22).

Roberts

This patent discloses a method of making a crank having a crank pin containing a reinforcing member. In the prior art the crank pin had been reinforced by inserting a solid rod at the place where the crank pin was cast. This strengthened the crank pin but the bearing surface was not as good as desired. The patentee discloses the insertion of a tube P to reinforce the crank pin, the molten metal for the crank being poured within the tube and about the ends. The patent states that the tube strengthens the pin to resist shock or torsion.

Dow

This patent relates to the production of light weight structural members of high strength. The patent describes the production of a connecting rod, as an example. First a two part steel shell 1 is formed by stamping, the parts being provided with openings 2 and 3 for bearings. The steel shell parts being placed together, molten magnesium is poured into the shell, through openings 4. After cooling, the product is subjected to a pressing operation to compensate for the contraction of the magnesium in cooling. In this operation depressions 6 are formed. The product produced by this method has the lightness imparted by magnesium, and the strength imparted by steel.

Armstrong

This patent relates to the production of a hollow drill rod, provided with a reinforcing metal tube. The patentee overcomes breakage of hollow drill rods by provid-
93 ing a reinforcing member of tougher composition.
The hollow drill rod is made by first preparing a hollow ingot containing the reinforcing member, and then rolling the ingot to drill size.

In figure 1 the hollow ingot is cast with a tough metal tube 14 inserted therein. Figures 4, 5, 6, and 7 show various shapes of the insert. In Figures 8 and 9 the insert is at the exterior, while Figure 11 shows several inserts at spaced distances from the axis.

Claim 12:

This claim is considered unpatentable over Roberts because the crank pin P is embedded integrally in the cast crank; the metal of the crank pin is of a different composition than that of the crank; and there is no clear distinction between the location of the crank pin P and the recitation of the location of the insert in the claim. Since the crank is subjected to forces, and the so-called lines of forces are present throughout the crank, the crank pin intersects the so-called lines of force. The recitation "extending away from the area of maximum stress toward areas of lesser stresses" is not considered as distinguishing the location of the insert because, while it is not clear where the areas of maximum stress and of lesser stress are in the Roberts crank, the crank pin extends through a relatively wide cross section, and would apparently cut lines of force in both high stress areas and low stress areas. Moreover, there is no evidence of record that the placing of the insert at the low stress areas produces increased strength. The patentee states that he obtains reinforcement when the insert is placed as in the patent. Applicant's argument to the contrary, based on theory only, is not regarded
94 as a sufficient basis for holding to the contrary, especially when it is common in structural design to place reinforcing material at the places of higher stress instead of at regions of lower stress.

Claim 12 is considered unpatentable over Dow, who shows the reinforcing material on the outside. Although the magnesium is cast into the reinforcing shell, the finished article may also be regarded as one having an insert of magnesium in the shell. Since the insert occupies such a large area, it is believed that it is both in the area of maximum stress and low stress.

Claim 12 is considered unpatentable over Armstrong who shows the reinforcing tube at practically all zones, the exterior, the center, and the intermediate zones. The reinforcing member necessarily, then, is in the zone claimed.

Claim 13:

This claim is considered unpatentable similarly to claim 12. The claim adds the limitation that the insert is completely embedded. But, page 3, lines 5 and 6 of the specification, shows that it is not significant whether the insert is completely or partially embedded.

Claim 14:

This claim is considered unpatentable over Armstrong in the same way the reference is used above.

Claim 15:

This claim is considered unpatentable in the same way
as claim 12. The patentees obtain reinforcement by the
use of a tougher reinforcing member, placed in various
parts of the casting. Inasmuch as the patentees,
95 particularly Armstrong, show the location of the in-
serts in substantially each significant zone, it is be-
lieved that there is no distinction in actual location of the
insert. The reference to lines of force is merely a reference
to an inherent property.

Claim 16:

This claim is considered unpatentable in the same way as claim 12. On page 5, lines 18 to 20, there is a statement that in some cases a metal insert of lower modulus of elasticity may be used. The patentees show the use of metal of high modulus of elasticity for the reinforcing member, but in view of the statement in the specification, there is no unexpected advantage, or significance, in the use of a metal insert of high modulus of elasticity, at least when considered from the point of view of castings generally, as distinct from a specific article.

Respectfully,

A. LINDSAY,
Examiner.

* * * * * * * * * *

103 Mailed Oct 15 1942

Appeal No. 42,071 OB Paper No. 22

Hearing: September 23, 1942

In the United States Patent Office

Before the Board of Appeals

Ex parte Ernst Zingg

Application for Patent filed February 19, 1940, Serial No. 319,597. Cast Metal Parts.

Messrs. Parker & Carter for appellant.

This is an appeal from the action of the Primary Examiner finally rejecting claims 12 to 16, inclusive.

Claim 12 is illustrative and reads as follows:

12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.

The references relied upon are:

Roberts, 209,836, Nov. 12, 1878
Dow, 1,296,373, Mar. 4, 1919
Armstrong, 1,718,210, June 25, 1929

The rejected claims recite a metallic casting having embedded therein a second metallic member whose modulus of elasticity is different from the modulus of elasticity of
the cast metal. We believe that the examiner's re-
104 jection is waranted because the structure recited in
the claims is substantially that stated above.

Furthermore, there is no question but that an inserted piece in the prior art intersects certain lines of force. The recitation of the position of the inserted piece as recited—extending away from the area of maximum stress toward areas of lesser stress—is quite likely true in the prior art constructions although there may be no statement to that effect in the patent specifications.

We note also, as did the examiner, that the question of having an insert of high modulus of elasticity is not important as it may be lower. In any event, the materials inserted in the references would have a different modulus of elasticity from the cast metal. We are not convinced that appellant's location of his inserted material would have any special effect in spreading the stresses but even aside from that, we think that the claims do not differ in terms from the prior art as discussed by the examiner. As far as structure is concerned, the claims involve introduction of a metal having a different character from the cast iron within the cast product.

The method claim is unwarranted as not defining a proper method. As far as the method is concerned, it merely involves inserting a metal of another character in an iron casting, which is obviously not patentable.

For reasons more fully discussed by the examiner, the decision of the examiner is affirmed.

W. L. REDROW,
Examiner-in-Chief,

E. T. MORGAN,
Examiner-in-Chief,

J. W. CLIFT,
Examiner-in-Chief,
Board of Appeals.

October 15, 1942.
Parker & Carter,
8 S. Michigan Ave.,
Chicago, Ill.

* * * * * * * * * *

EXCERPTS FROM DEFENDANT'S NO. 1.

E. A. L. ROBERTS.

Casting Cranks.

No. 209,836. Patented Nov. 12, 1878.

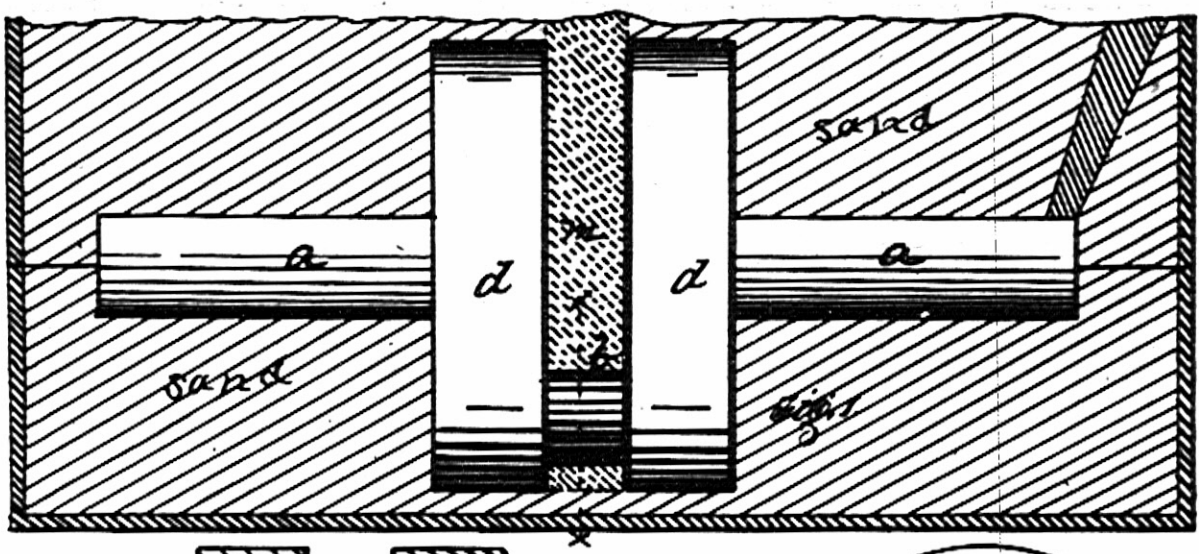


Fig. 1

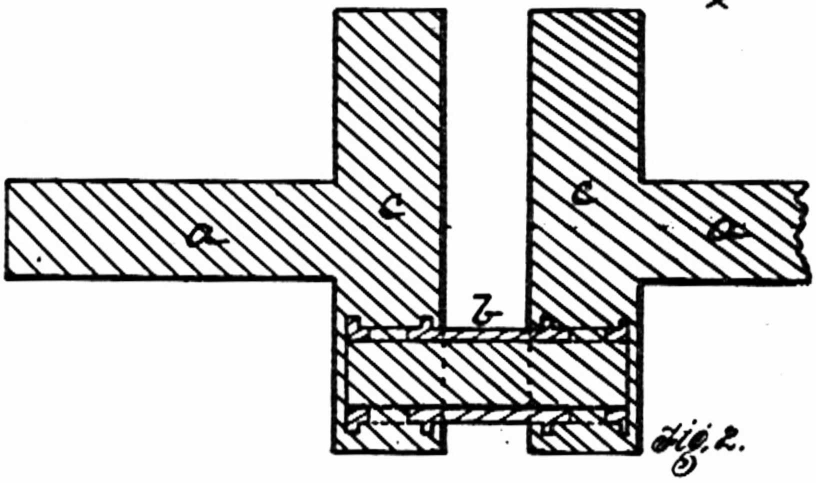


Fig. 2.

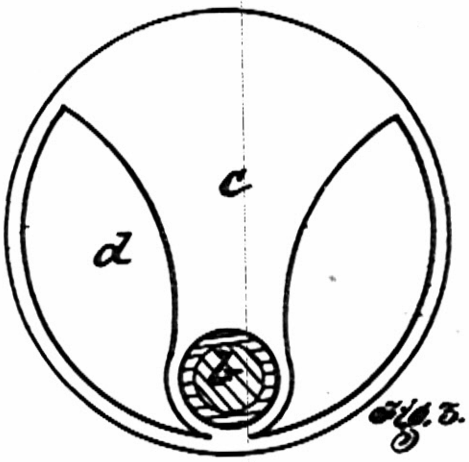


Fig. 3.

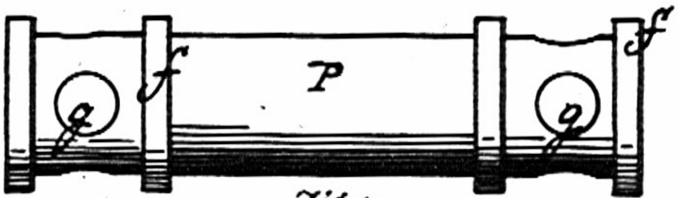


Fig. 4.

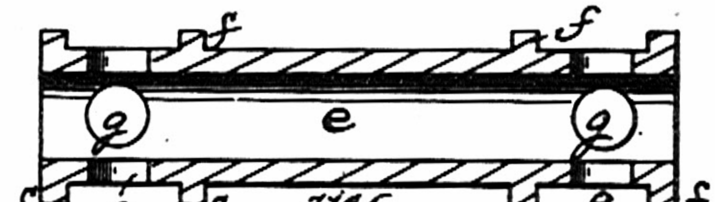


Fig. 5.

WITNESSES

R.W. Fenchall

John K. Smith

INVENTOR

Edward A. L. Roberts

by Bakewell & Kerr

Attys

UNITED STATES PATENT OFFICE.

EDWARD A. L. ROBERTS, OF TITUSVILLE, PENNSYLVANIA.

IMPROVEMENT IN CASTING CRANKS.

Specification forming part of Letters Patent No. **209,836**, dated November 12, 1878; application filed October 11, 1878.

To all whom it may concern:

Be it known that I, EDWARD A. L. ROBERTS, of Titusville, in the county of Crawford and State of Pennsylvania, have invented a new and useful Improvement in the Manufacture of Cranks; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawing, forming part of this specification, in which—

Figure 1 is an elevation of a pattern for a crank embodying my invention, and sectional view of a flask and mold. Fig. 2 is a longitudinal central section of a cast crank. Fig. 3 is a transverse section on the line of one end of pattern and pin. Fig. 4 is an elevation of the crank-pin re-enforce. Fig. 5 is a longitudinal section of the same.

My invention relates to the manufacture of cranks for engines and all classes of machinery, especially where large and strong cranks are required.

Heretofore it has been customary to manufacture cranks either by forging, which is expensive and laborious, or by casting the same of cast-steel, which is also expensive, and uncertain in its results, owing to the difficulty of getting perfect cast-steel castings; and in such castings a solid rod has been inserted in the mold at the position of the crank-pin and incorporated with the casting; but the cast metal of the pin is not protected thereby, nor is a good wearing-surface obtained on the crank-pin.

The object of the present invention is to properly re-enforce the crank-pin, so that cheap, strong, and durable cast-iron cranks may be readily produced.

I will now proceed to describe my invention, so that others skilled in the art to which it appertains may apply the same.

In the drawing, *a* indicates the shaft of the pattern and casting; *b*, the crank-pin of pattern, and *c* the arms or completed crank counterbalances. The form I prefer is that shown, the counter-balances *c* being parts of two disks or wheels, *d*, which act somewhat as fly-wheels; but the form is not essential to the manner of producing, and any preferred or desired form may be chosen to meet the requirements of the case or the fancy of the constructer.

P, Figs. 4 and 5, shows one form given to the metallic re-enforce for the crank-pin, which is the essential feature of this invention. This crank-pin re-enforce should be hollow, as at *e*, and is preferably provided with flanges *f* and holes or perforations *g*, so that in casting the cast metal will become incorporated with the re-enforce.

The crank will be, by preference, cast in the position shown in Fig. 1, the space in the mold indicated by *m* being filled with a divided disk-core adapted to inclose the crank-pin re-enforce P, and support the same in its position in the mold, the communication between the two parts of the mold being through *e* of the hollow pin P.

The crank-pin P or re-enforce being in position in the mold with the core, the molten metal is preferably cast from one end of the shaft, and sufficient metal run through the mold, and, of course, through the pin, to insure a perfect union of the pin P with the casting.

When completed the pin or re-enforce will be held by the cast metal, and frequently, if not always, will be thoroughly united or fused thereto. The tube or sleeve P, inclosing the cast metal of the crank-pin, will not only strengthen the same to resist shocks or torsion, but will at the same time afford a superior bearing-surface.

The metal of which the pin P is formed is preferably steel, though brass, wrought-iron, and other suitable metals may be used. Cross-head pins and various other steel fixtures or pins can be combined with cast-iron castings in like manner.

I am aware that a skeleton-wheel has been employed to re-enforce cast-metal car-wheels, and also that a solid metal rod or re-enforce has been cast into a crank, and do not claim such subject-matter; but,

Having thus described the nature and advantages of my invention, what I claim, and desire to secure by Letters Patent, is—

1. An improvement in the process of manufacturing a crank-axle, consisting in plac-

H. H. DOW.

MECHANICAL OR STRUCTURAL ELEMENT.

APPLICATION FILED JULY 14, 1916.

1,296,373.

Patented Mar. 4, 1919.

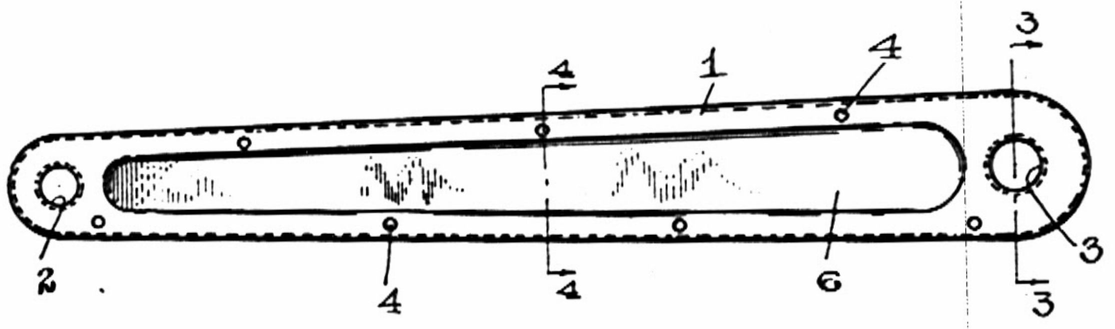


Fig. 1.

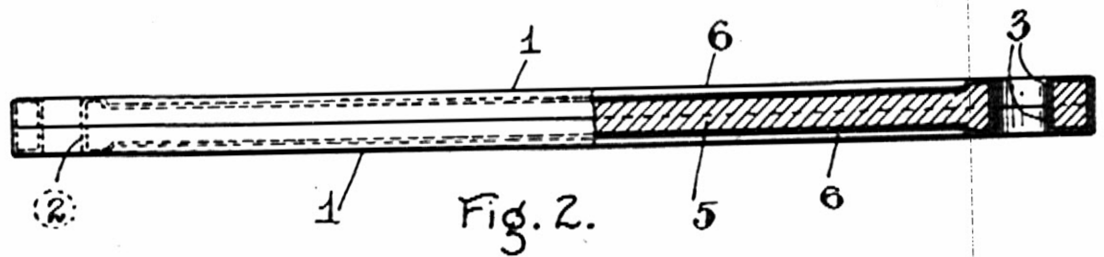


Fig. 2.

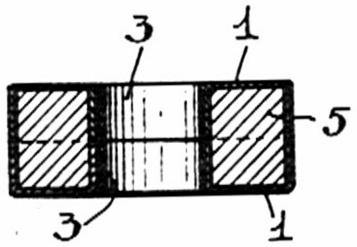


Fig. 3.

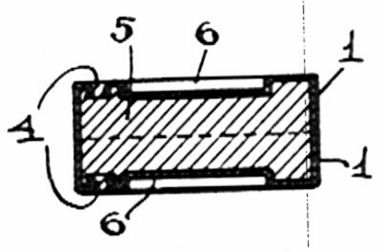


Fig. 4.

Witnesses:
O.M. Kappler
Mary Gladwell

Inventor
HERBERT H. DOW.
by Fay, Oberlin & Fay
Attorneys.

ing a tubular perforated re-enforce in a mold properly constructed and casting the crank-shaft within and through it, so as to become incorporated therewith and form a bearing-surface thereon, substantially as and for the purpose specified.

2. A crank having a hollow crank-pin cast into the same, into, through, and around which pin the metal of the casting passes, substantially as and for the purpose specified.

In testimony whereof I, the said EDWARD A. L. ROBERTS, have hereunto set my hand.

EDWARD A. L. ROBERTS.

Witnesses:

F. W. RITTER, Jr.,

C. H. ROBERTS.

UNITED STATES PATENT OFFICE.

HERBERT H. DOW, OF MIDLAND, MICHIGAN, ASSIGNOR TO THE DOW CHEMICAL COMPANY, OF MIDLAND, MICHIGAN, A CORPORATION OF MICHIGAN.

MECHANICAL OR STRUCTURAL ELEMENT.

1,296,373. Specification of Letters Patent. **Patented Mar. 4, 1919.**

Application filed July 14, 1916. Serial No. 109,216.

To all whom it may concern:

Be it known that I, Herbert H. Dow, a citizen of the United States, and a resident of Midland, county of Midland, and State of Michigan, have invented a new and useful Improvement in Mechanical or Structural Elements, of which the following is a specification, the principle of the invention being herein explained and the best mode in which I have contemplated applying that principle, so as to distinguish it from other inventions.

There are many instances, in machine or other structures, where the lightness of an element or member is a matter of considerable importance, providing it can be achieved while still retaining sufficient strength. Thus spars for yachts, ribs for aeroplane wings, and pitmen or connecting rods for high-speed engines and the like, are illustrative instances of the sort in mind. The object of the present improvement is to provide an element extremely light for use in connections such as those indicated, which will combine the necessary tensile strength with sufficient rigidity to enable the member to withstand the compression strains to which it will be subjected as well. To the accomplishment of these and related ends, the invention consists specifically of a shell of high-grade steel which will be relatively light compared with the weight of a solid member of the same material, but which will nevertheless be strong enough to withstand the tensile strains to which the member may be properly subjected. This shell is then filled with molten magnesium which, upon solidifying, provides for the compression strains.

The annexed drawing and the following description set forth in detail certain mechanism embodying the invention, such disclosed means constituting, however, but one of various mechanical forms in which the principle of the invention may be used.

In said annexed drawing:—

Figure 1 is a side elevational view of a mechanical element, specifically a pitman or connecting rod, constructed in accordance with my present invention; Fig. 2 is a longitudinal central section thereof; and Figs. 3 and 4 are transverse sections thereof taken on planes indicated by the lines 3—3 and 4—4, respectively, in Fig. 1.

Referring to the particular structure illustrated in the aforesaid drawing, the steel shell will be seen to be composed of two parts 1, 1, preferably made up in the form of stampings, and each conveniently representing half of the complete article. Such shell sections 1, 1 are provided at their respective ends with complementary tubular bosses 2, 2 and 3, 3, which, when the parts are fitted together, form transverse holes for the reception of suitable bearing sleeves or bushings (not shown), as will be readily understood. Each of the shell sections, furthermore, is provided with a plurality of undercut projections 4, on its inner face, these likewise being conveniently stamped up from the material of which the sections are composed, as indicated in Fig. 4.

With the sections held together in any suitable way, molten magnesium is then poured into the hollow space between the same until such space is entirely filled, a suitable sprue opening (not shown) being provided where most convenient in the one section or the other, or on the line of junction between the two. The magnesium as soon as it cools forms a solid core 5, which will obviously interengage with the undercut projections on the inner faces of the sections, and so serve to tie the latter together. If added security, however, in this respect is desired, transverse bolts (not shown) may be utilized.

Owing to the fact that metallic magnesium, upon cooling, tends slightly to contract in bulk, and so would be left, in a degree, under tension, in order to complete the article I deform the shell by placing the article, after the core has thus cooled, in a suitable press, and press in portions of the sides of the sections, as at 6, 6, so as to reduce the contained volume and thereby take up any left over space. The magnesium being quite malleable will flow, or give way, to accommodate itself to the restricted interior of the shell, and the resultant structure will have the aspect of an article fashioned out of homogeneous material. In view of the lightness of the steel shell which will suffice for the tensile requirements, and the fact that the core of magnesium has a very low specific gravity (1.70), it will be seen that a remarkably light article is produced. Of course, the magnesium core will take up some tensile strains and conversely the steel shell will take up some compression strains, when prevented from buckling by the presence of such core. In other words the two mutually reinforce each other. This results more especially from the deformation of the cross-section of the shell, whereby the contained space is decreased and all internal strains relieved, much the same as by the annealing of a metal article of uniform composition.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel, and a core of lighter malleable metal, substantially as described.

2. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel, and a core of lighter metal cast therein, the walls of said shell being thereupon compressed, substantially as described.

3. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel, and a core of lighter metal cast therein, the walls of said shell being thereupon compressed from opposite sides so as to reduce the contained space in said shell.

4. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel, and a core of magnesium.

5. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel, and a core of magnesium, the walls of said shell being thereupon compressed to reduce the contained space in said shell.

6. As a new article of manufacture, a structural or mechanical element consisting of a shell of steel strong enough to withstand tensile strains, and a core of magnesium cast in said shell to render the same capable of withstanding compression strains, the walls of said shell being deformed after said core has cooled, so as to reduce the contained space in said shell.

7. As a new article of manufacture, a structural or mechanical element consisting of a shell made of plural parts, and a core of lighter metal, the latter inter-engaging with the parts of said shell to hold the same together.

8. As a new article of manufacture, a structural or mechanical element consisting of a shell made of plural parts, and a core of lighter metal cast in said shell and inter-engaging with the parts thereof to hold the same together.

9. As a new article of manufacture, a structural or mechanical element consisting of a shell made of plural parts, and a core of lighter metal cast in said shell and inter-engaging with the parts thereof to hold the same together, said shell being thereupon deformed so as to reduce the contained space in said shell.

10. As a new article of manufacture, a structural or mechanical element consisting of a shell made of plural parts having undercut projections on their respective inner faces, and a core of magnesium cast in said shell and engaging with such projections so as to hold said shell-parts together.

11. As a new article of manufacture, a structural or mechanical element consisting of a shell made of plural parts having undercut projections on their respective inner faces, and a core of magnesium cast in said shell and engaging with such projections so as to hold said shell-parts together, said shell being deformed after said core has cooled, so as to reduce the contained space in said shell.

Signed by me this 6th day of July, 1916.

HERBERT H. DOW.

Attested by—
A. N. PATRIARCHE,
JNO. F. OBERLIN.

June 25, 1929. **P. A. E. ARMSTRONG** **1,718,210**

PROCESS OF MAKING HOLLOW DRILL RODS

Filed Jan. 12, 1922 3 Sheets-Sheet 1

Fig 1

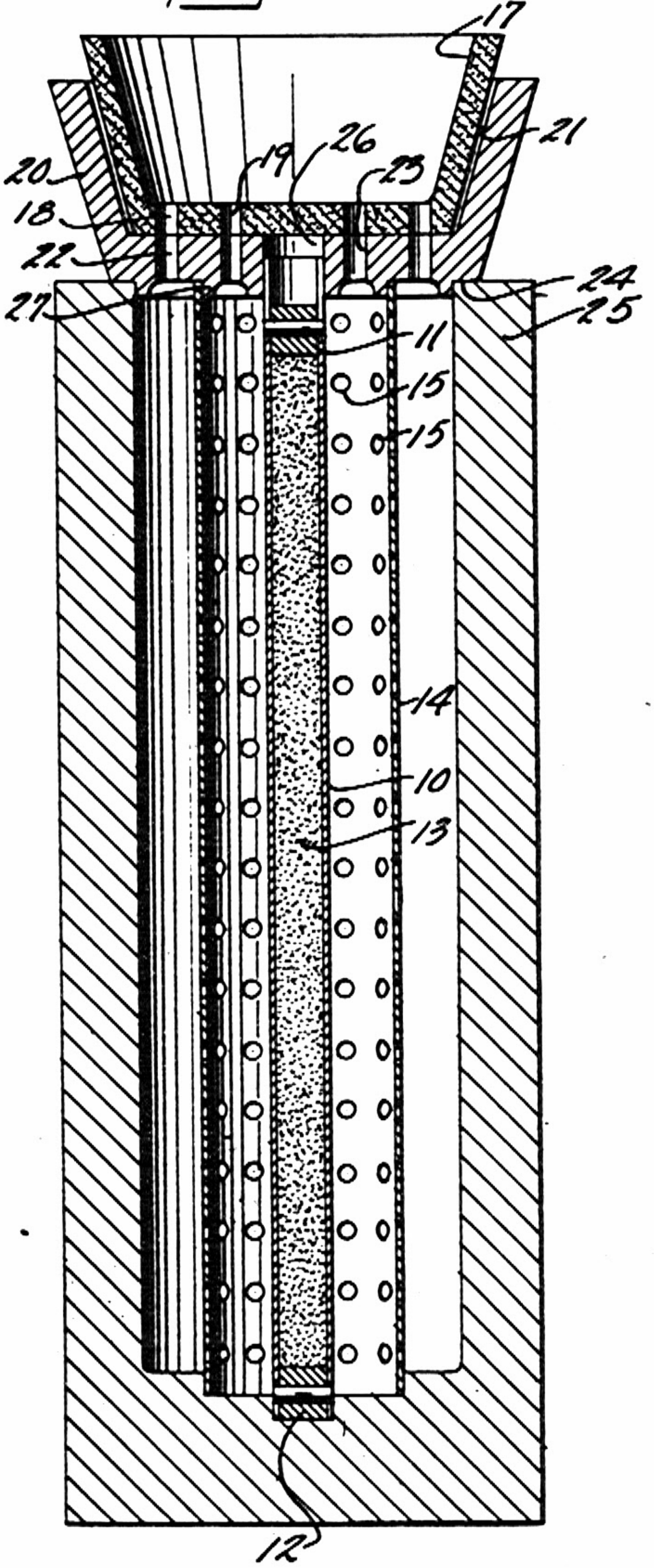


Fig 3

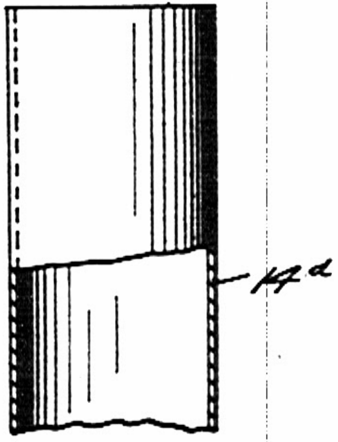


Fig 2

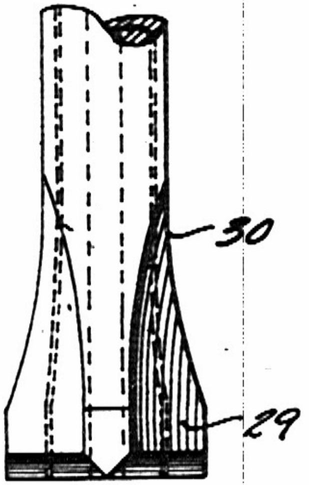
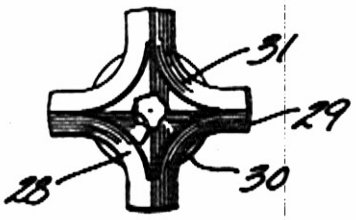


Fig 2ᵃ



INVENTOR

Percy A. E. Armstrong

BY

ATTORNEY

June 25, 1929. P. A. E. ARMSTRONG **1,718,210**

PROCESS OF MAKING HOLLOW DRILL RODS

Filed Jan. 12, 1922 3 Sheets-Sheet 2

Fig. 4

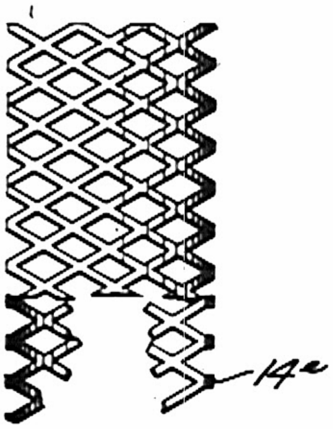


Fig. 5

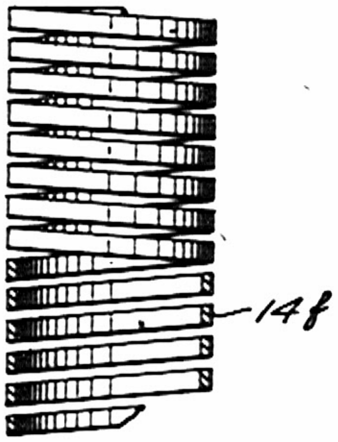


Fig. 6

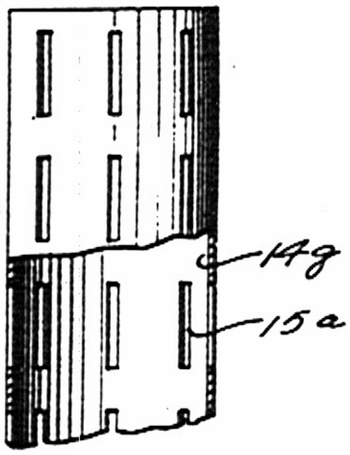


Fig. 7

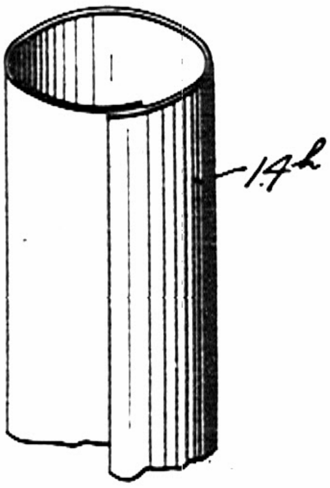


Fig. 8

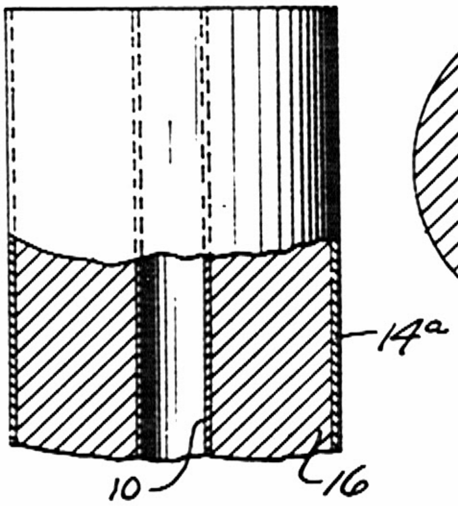


Fig. 10

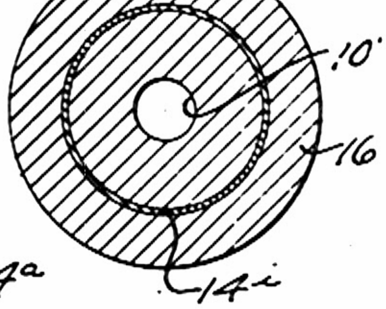


Fig. 11

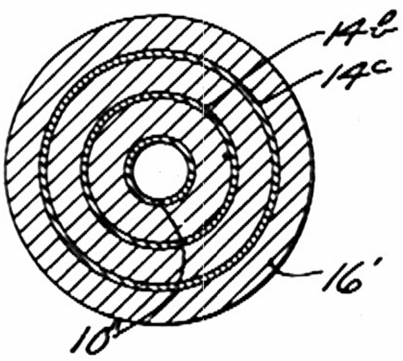
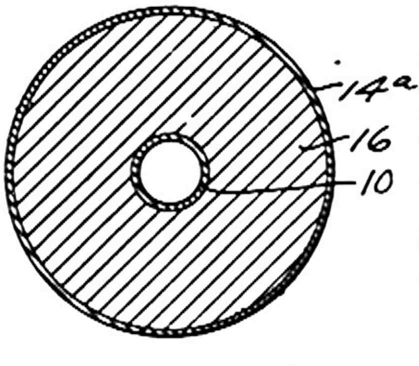


Fig. 9



INVENTOR

Percy A. E. Armstrong

BY H H Dyke

ATTORNEY

June 25, 1929. P. A. E. ARMSTRONG **1,718,210**

PROCESS OF MAKING HOLLOW DRILL RODS

Filed Jan. 12, 1922 3 Sheets-Sheet 3

Fig. 12

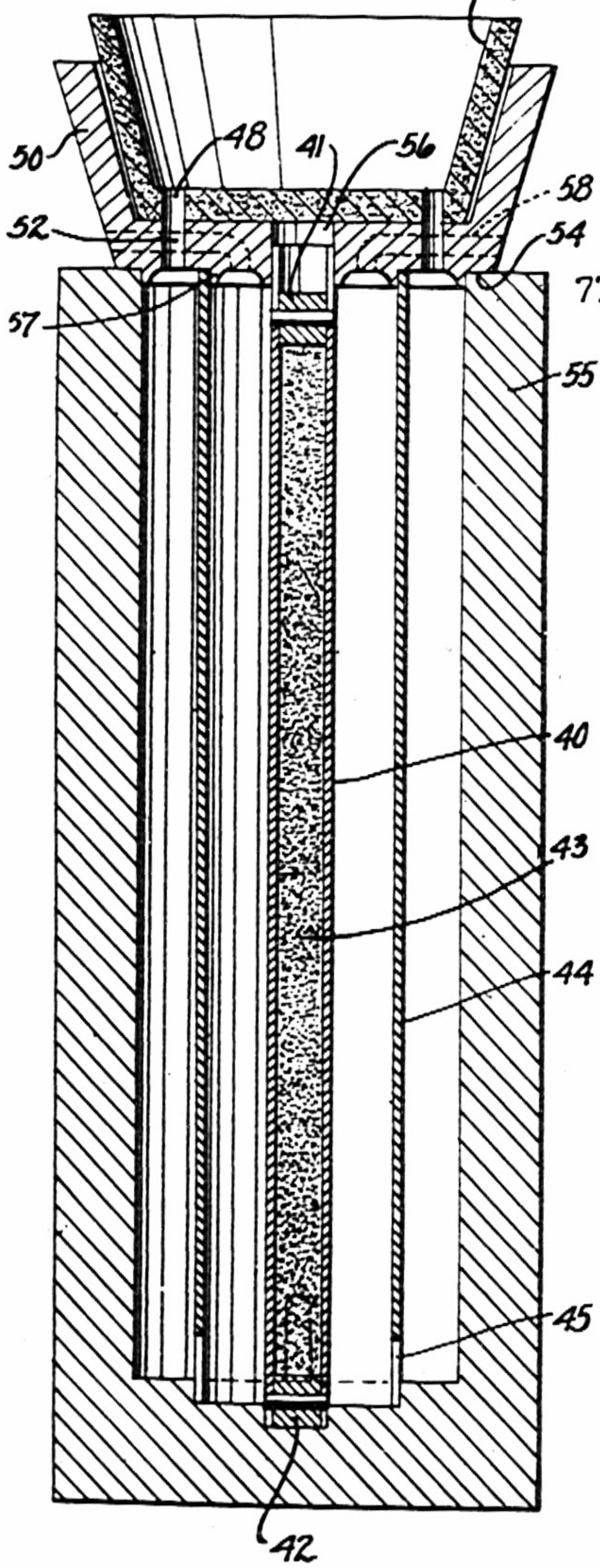
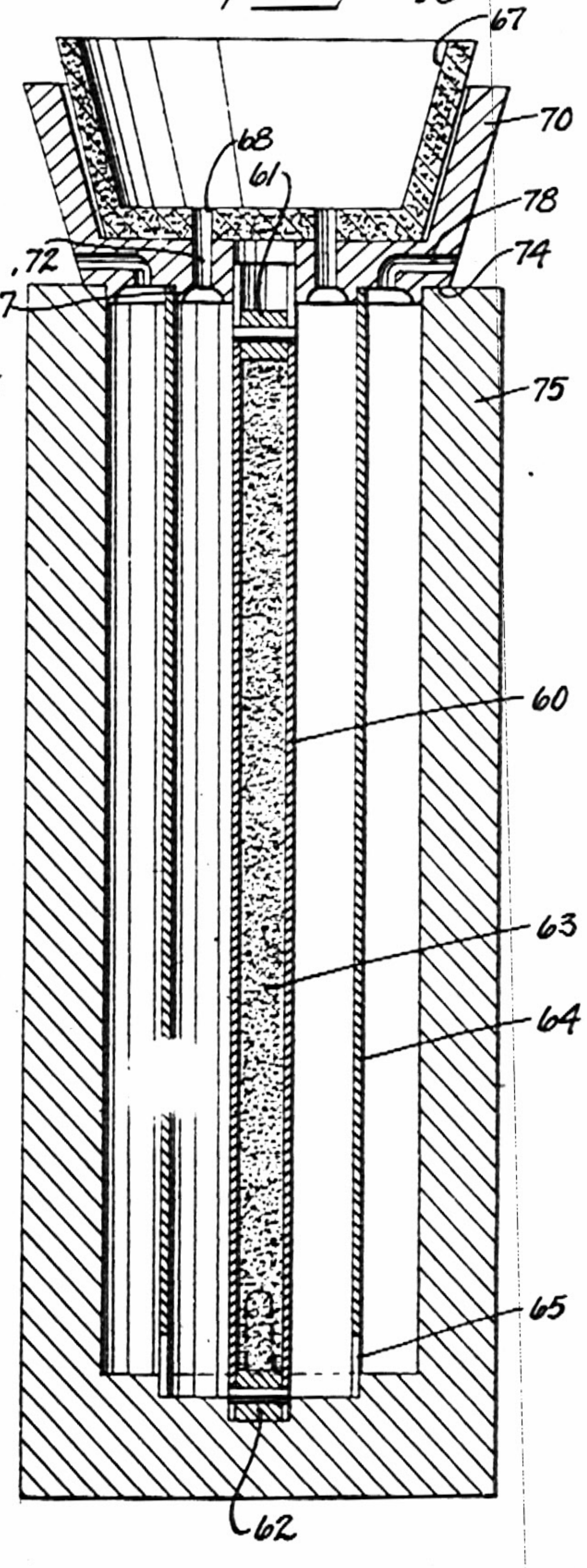


Fig. 13



Percy A.E. Armstrong INVENTOR

BY H.H. Dyke

ATTORNEY

Patented June 25, 1929. **1,718,210**

UNITED STATES PATENT OFFICE.

PERCY A. E. ARMSTRONG, OF LOUDONVILLE, NEW YORK, ASSIGNOR TO LUDLUM STEEL COMPANY, OF WATERVLIET, NEW YORK, A CORPORATION OF NEW JERSEY.

PROCESS OF MAKING HOLLOW DRILL RODS.

Application filed January 12, 1922. Serial No. 528,753.

My invention relates to hollow drill rod and other hollow bar products, and will herein be described for affording an understanding of the invention with reference to hollow drill rod for mine drills. The material and process may also be employed in the construction of axles, steam hammer shafts and for many other purposes of like character where there has been experienced with materials hitherto available fatigue or progressive cracks starting from a transverse fissure.

Rock drills made of the hard steel required for rock penetration are subject to breakage from the tremendous vibratory stresses encountered in use. Such breakage may occur in various ways, as, for example, the drill shaft may break off, or the steel may crack or break radially out from the hollow center, etc.

According to my invention the hard steel of the rock drill is provided with a tough reenforce, as, for example, a reenforce of low carbon steel or other tough material, which serves to prevent breakage without substantial loss of cutting power, and in fact increased cutting power can be obtained, since the provision of the reenforce enables the use of harder steel than could otherwise be used. For example, steel containing over 1% and as high as 1.15% of carbon may be used for the body of the drill rod, while the reenforce may be of mild steel containing under .4% of carbon, as, for example, about .35% of carbon.

The tough reenforce is preferably of generally tubular form, which is best adapted to prevent shaft and radial breaks and give all around strength to the drill steel, but reenforces of various forms may be used.

In the accompanying drawings, Fig. 1 is a vertical sectional view of an ingot mold arranged for pouring an ingot to be rolled out into hollow drill steel. Fig. 2 is a side view and Fig. 2^a an end view of a drill head forged from hollow drill rod embodying my invention. Figs. 3, 4, 5, 6 and 7 are side views, partly in section, of variously formed reenforces for use in the manufacture of drill rod embodying my invention. Figs. 8 and 9 are respectively longitudinal and cross-sectional views of drill rod with an exterior reenforce, and Figs. 10 and 11 are cross-sectional views of drill rod with internal reenforces. Figs. 12 and 13 are vertical sectional views of modified forms of the ingot mold of Fig. 1.

The bore of the drill rod may be obtained in any desired way within the scope of the present invention, but preferably the ingot to be rolled down to drill size comprises a central tube of mild steel welded in place in the casting of the ingot, as described and claimed in my Patent #1,565,771, dated December 15, 1925, and in Fig. 1 I have shown such central tube 10 plugged at its ends as indicated at 11 and 12, and filled with material 13 such as sand, hard burned magnesite, lime, talc, etc., but which may be herein referred to for convenience as sand. Reference numeral 14 represents the reenforcing member of tough material such as low carbon steel, for example, which is preferably placed in the ingot mold between the central tube and the outer wall of the mold. It may be placed elsewhere, as on the outside of the mold, if desired, as shown at 14^a, Figs. 8 and 9, and two or more reenforcing members may be provided, if desired, as shown at 14^b, 14^c, Fig. 11.

The form of the reenforcing member is preferably tubular so as to be well adapted to resist radial breakage extending out from the hollow center, as well as breakage across the shaft and in other directions, but considerable latitude is permissible in the form of the reenforcing members and several forms are shown herein as examples. Fig. 3 shows a simple form of tube reenforce 14^d without openings or perforations of any kind. Fig. 1 shows a similar tube 14, but provided with a plurality of round holes 15. Fig. 4 shows a reenforcing member 14^e of expanded metal, such as commonly used for metal lath, etc. Fig. 5 shows a coiled tubular reenforce 14^f, and the coiled material may be of any desired cross-section, as well as the flat section shown. Fig. 6 shows a tube 14^g with longitudinally extending slots 15^a. Fig. 7 shows a tubular member 14^h made by rolling up a piece of flat sheet metal. The meeting edges of the metal for reenforce 14^h may be arranged in various ways. For example, they may abut closely together at 14^i as shown in Fig. 10, or they may be separated by a short distance, or may lap over one another, if desired, the last named arrangement being illustrated at 14^h in Fig. 7. In Figs. 8 and 9 the reenforce 14^a is placed on the outside of the drill rod.

In the cross sectional view of Fig. 10, I have shown a drill rod with the customary central opening 10′ therein, and having a tubular reenforcing member 14^i substantially midway between the central opening 10′ and the exterior wall of the drill rod 16. In Fig. 11 the drill rod 16′ has a lined opening 10″ formed by welding a tube 10 within the ingot in casting, and is provided with two substantially concentric reenforces 14^b, 14^c. In Figs. 8 and 9 the central opening has a wall 10 similar to the wall of Fig. 11, and the reenforce 14^a is provided about the exterior of the drill rod. When the reenforcing material is provided by the outside of the drill rod, as shown in Figs. 8 and 9, the removal of such softer material 14^a at the drill head, as by grinding it off either before or after forging the lands, enables the user to obtain a drill shank of the requisite strength and toughness, and at the same time to obtain a cutting edge free from soft material, and the outer ends of the cutting lands may be readily brought to correct gauge in grinding off the soft metal 14^a.

In pouring the ingot, the molten steel is preferably introduced by means of a pot 17 of graphite or the like, having outlet holes 18, 19 for the molten metal, and a holder 20 is preferably provided having a recess 21 to receive the pot 17, and having holes 22, 23 in alignment with the holes 18, 19 in the pot 17.

The holder 20 is preferably shouldered at 24 to set within the ingot mold 25, and has a central opening or recess 26 to receive the core tube 10, and is provided with a shoulder 27 to fit within and center the reenforcing tube 14. When the reenforcing member is apertured, as in several of the instances shown, round holes 15 being shown in Fig. 1, it may be sufficient to pour the molten ingot material through holes 18 and 22 outside the reenforce 14, and to depend on the passage of molten metal through holes 15 to the interior of reenforcing tube 14, but where a simple non-apertured reenforcing tube is used, or where the apertures are not extensive, it is preferable to make provision for entry of the molten metal from the pouring device direct into all the ingot spaces, as, for example, through holes 19 and 23 into the space within the reenforcing tube 14. Where a plurality of reenforcing tubes are made use of, as in Fig. 11, for example, additional pouring holes may be provided, as will be readily understood.

Referring to Fig. 12, there is shown an ingot mold arranged for pouring an ingot to be rolled out into hollow drill steel. The bore of the drill rod may be obtained in any desired way, but preferably the ingot to be rolled down is formed around a central tube 40, and this tube is positioned within the mold, as clearly shown in the drawing. The ends of the tube 40 are plugged by means of suitable plugs 41, 42 and its interior filled with a material 43, such as sand, hard burned magnesite, lime, talc, or the like, but which is herein referred to for convenience as sand. The reenforcing member of tough material comprises a tube 44 formed of low carbon steel, for example, which is placed in the ingot mold between the central tube 40 and the outer wall of the mold. The lower extremity of the tube 44 is provided with a plurality of notches, such as 45, forming passages between the spaces in the mold on either side of the tube 44.

For pouring the ingot there is provided a pot 47 made of graphite or the like, having outlet holes, such as 48, each of which is in alignment with a corresponding aperture 52 in a pot holder 50. The holder 50 preferably is shouldered at 54 to set within the ingot mold 55 and has a central opening or recess 56 to receive core tube 40. It is also provided with a shoulder 57 to fit within and center the reenforcing tube 44. The holder 50 is provided with a plurality of vent passages, such as 58, interconnecting the interior of the mold with the atmosphere.

In pouring the ingot the molten steel is introduced into the mold by means of the pot 47 and flows through the apertures 48 and 52 into the space between the tube 44 and the outer wall of the mold 55. The molten material passes through the passages 45 and upwardly in the space between the tubes 44 and 40. Thus it will be seen that the ingot is formed and when cooled takes the shape desired. The ingot may subsequently be elongated to desired dimensions in any appropriate manner, as for example, by rolling.

In the modified form of the invention shown in Fig. 13, there is provided a mold similar to that of Figs. 1 and 12, in which there is positioned a central tube 60 having its ends plugged by suitable plugs 61 and 62, and its interior filled with suitable material 63, such as sand or the like. A tube 64 of tough material, such as mild carbon steel, is positioned in the space between the central tube 60 and the outer wall of the mold. The lower end of the tube 64 is provided with a plurality of notches 65 forming pasages between the spaces within the mold, partitioned off by the tube 64. A pot 67 formed of graphite or the like is provided for the molten metal. A pot holder 70 is positioned on the upper extremity of the mold and has an annular shoulder 74 for maintaining it in position. The holder 70 is provided with a second shoulder 77 arranged to fit within the tube 64 and maintain the tube 64 in position. The pot 67 is provided with a plurality of passages, such as 68, through its bottom, each of which is in alignment with a passage 72 extending through the holder 70 and connecting with the space between tubes 60 and 64. A plurality of vents, such as 78, extend through the holder 70 and connect one of the spaces in the mold with the atmosphere.

In pouring an ingot the molten metal is introduced by means of the pot 67 and flows through the passages 68 and 72 into the space within the mold between the tubes 60 and 64. It then flows through the passages 65 and upwardly into the space between the tube 64 and outer walls 75 of the mold. Thus the ingot is formed within the mold and after having been cooled may be elongated to desired dimensions in any suitable manner.

It is to be understood that various materials, such as carbon steels and alloy steels, may be used both for the body of the ingot and the reenforcing means, so long as the body thereof is adapted to give the cutting or other qualities desired, and the reenforce to give adequate toughness and freedom from breakage.

A reenforcing tube of nickle, for example, gives good results in making hollow drill rod. The reenforcing tube is preferably quite thin, as compared with the body of the metal, and the molten metal of the ingot is preferably poured fairly hot, so that the reenforcing material becomes welded to the material of the body of the ingot during the formation of the ingot, or during the rolling down of the ingot to the drill rod size, or both.

In the making of the drill rod, the heated ingot is rolled to the desired dimension and the sand removed in known manner, leaving the bore 28 for supplying water to the drill head. When the reenforce or reenforces are arranged intermediate the central bore and the exterior of the drill rod and the drill head is forged out to gauge, the reenforcing material will appear to some extent in the lands 29 of the drill gauge 30, as indicated at 31, Fig. 3, but due to deformation in forging and the relatively slight thickness of the wall of reenforcing material, which is sufficient to prevent breakage, no substantial loss of cutting power is encountered and in fact cutting power can be increased as harder steel can now be used for the body of the drill rod, without being subject to cracks or breaks.

A heat treatment may now be given, either wholly or only on the bit end, the opposite end or both ends, as desired. A heat treatment which I have found advantageous comprises heating the part or parts to be treated to a temperature above that of the transformation point, and rapidly cooling in a cooling medium, such as water or the like.

It is to be understood that the various forms shown in the drawings are for illustration only, and that changes and modifications may be resorted to without departing from my invention.

I claim:

1. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises casting a hollow ingot with a metallic tubular member in place in the ingot mold, and at such distance from the ingot mold walls as to be surrounded on all sides by the cast metal and elongating and reducing the cross-section of the resulting ingot.

2. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises casting a hollow ingot about a central core with a relatively thin reenforcing metallic substantially tubular member of tougher material than the ingot material in place in the mold, so as to be surrounded on all sides by the cast metal, whereby the reenforcing material is welded within the ingot, elongating and reducing the cross-section of the ingot and core, and removing the core.

3. The process of making hollow tubular bodies, such as hollow drill rod and the like, which comprises placing in an ingot mold an axially arranged tube, containing a sand core, and a substantially tubular member surrounding said tube and spaced away therefrom, casting a metallic ingot in said mold with said tube and member in place therein, whereby said member is surrounded on all sides by the cast metal, elongating and reducing the cross-section of the ingot and core, and removing the sand from the tube.

4. The process of making hollow drill rod, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and an apertured substantially tubular member of soft steel arranged substantially concentrically with said tube by introducing the molten material outside the apertured tubular member and permitting it to pass through the openings therein to fill the space about the tube, whereby tubular member and tube become welded within the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

5. The process of making hollow drill rod and the like, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and a substantially tubular member of soft steel arranged substantially concentrically with said tube, by introducing the molten material outside the tubular member and permitting it to pass under the bottom of the tubular member and then rising up to fill the space about the tube, whereby the tubular member and the tube become welded within the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

6. The process of making hollow drill rod and the like, which comprises casting an ingot of hard steel about a tube of soft steel containing a sand core and a substantially tubular member of soft steel arranged substantially concentrically with said tube, by introducing the molten material into the space about the tube, whereby the tubular member and the tube become welded within

the ingot, elongating and reducing the cross-section of resulting ingot and core, and removing the sand core.

7. Process of making hollow drill rod, which comprises arranging an ingot mold with a sand-filled central tube of substantially unhardenable steel, and with an apertured larger substantially concentric tube of substantially unhardenable steel around the central tube and spaced therefrom and from the ingot walls, casting hardenable steel in the space within the ingot mold about the central tube so that the larger tube is embedded in the cast metal, rolling the ingot, and removing the sand core, whereby a hollow drill rod is obtained which when made into drills can be hardened and given persisting sharp cutting edges and at the same time be reinforced by the substantially unhardenable steel portions.

In testimony that I claim the foregoing, I have signed my name hereto.

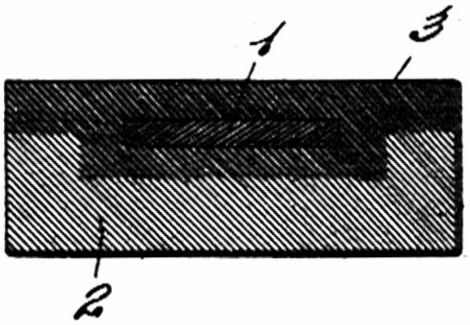
PERCY A. E. ARMSTRONG.

C. T. WESTLAKE.

ART OF CASTING.

APPLICATION FILED JAN. 7, 1910.

980,719. **Patented Jan. 3, 1911.**



WITNESSES.

E. M. Harrington.

Wm. Janus.

INVENTOR.

CHARLES T. WESTLAKE.

BY F. R. Cornwall, ATTY.

THE NORRIS PETERS CO., WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

CHARLES T. WESTLAKE, OF ST. LOUIS, MISSOURI.

ART OF CASTING.

980,719. Specification of Letters Patent. **Patented Jan. 3, 1911.**

Application filed January 7, 1910. Serial No. 536,844.

To all whom it may concern:

Be it known that I, Charles T. Westlake, a citizen of the United States, residing at St. Louis, Missouri, have invented a certain new and useful Improvement in the Art of Casting, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, forming part of this specification, in which, the figure is a conventional illustration of a piece of cast iron made in accordance with my improvement.

This invention relates to a new and useful improvement in the art of casting, being designed particularly as an improvement in the art of casting iron, steel, brass, etc.

Inserts have been arranged in the matrices of molds around which the molten metal has been poured, the object of these inserts being to strengthen the casting or to provide a metal having different physical properties from the metal which is cast around the insert. Illustrations in the first class may be found in the inserts which are arranged in car wheels to strengthen them, and in the latter class in brake shoes where steel and cast iron are combined to offer wearing faces having different physical properties. In all of these instances, so far as I am aware, the metal composing the insert is affected by the molten metal poured around it. This is particularly true of car wheels where the molten metal will heat the inserts and then when the wheel is put in the soaking pit where it remains, say 120 hours, the gradual reduction of temperature anneals the wheel and the insert, drawing the temper of the insert. The same action is true, but to a smaller degree, in the manufacture of brake shoes where the insert is a metal having a different physical property from the molten metal poured around it to form the casting. In all these instances, however, the hot molten metal coming in contact with the insert, changes some of the physical properties of the insert and this change is sometimes detrimental to the object in view. For instance, where a metal possessing a certain physical property is selected for an insert, it is desirable that that physical property be retained in the insert up to its full value.

I have discovered a metal which can be used for inserts in castings and whose physical properties will not be changed in such use.

My invention, therefore, broadly stated, is an improvement in the art of casting which consists in arranging an insert in the casting, the physical properties of which insert will not be changed from contact with the molten metal.

In the drawings, 1 indicates the insert, which is an alloy of iron having a manganese content of such percentage as is desirable or necessary to give it the requisite physical properties of tensile strength, hardness, ductility, etc. I have found that this alloy when subjected to the high temperature incident to contact with the molten metal which surrounds it, will not have its physical properties changed, but, on the contrary, the same physical properties of tensile strength, hardness, ductility, flexibility, elasticity, etc., which it possessed and because of which attributes renders it desirable for use as an insert, will remain unchanged and all of such physical properties will be possessed by the insert, to their full value, when the metal composing the casting cools to normal temperature. The fixed properties in this insert thus enable the metal composing the casting 2 to be treated in any of the well known ways, as, for instance, chilling the face 3 of said casting, in which event the insert 1 acts to deepen the chilling as indicated by the heavier cross section lines.

The metal composing the casting 2 may be tempered or reheated, etc., without in the least affecting the physical properties possessed by the insert 1. Hence the insert 1, if used as a reinforcing or strengthening medium, or for any other purpose on account of its physical properties, responds fully at all times to the requirements exacted of it.

I find that the best proportion of iron and manganese for this purpose range from about 85% to 96% iron and from about 13% to 3% manganese, but I do not confine myself to any particular percentage of either element, except that the iron should be the preponderating element, for the reason that if more than 13% of manganese is used the tensile strength of the alloy is affected and brittleness results.

The quantity of manganese used must be sufficient to render the insert immutable to varying temperatures. By burying the insert beneath the surface, it is possible for the surface of the casting to be continuous and unbroken and of the same substance of which the casting is composed. The insert is rendered inaccessible and this strengthens the casting without disturbing the metal of the casting on the surface.

Although I have mentioned this alloy as consisting of iron and manganese, the presence of other ingredients which are practically inseparable from iron in its commercial form, would not be a departure from the spirit of my invention, so long as such other ingredients do not detract from the desired qualities of the alloy.

It is, of course, obvious that the metal alloy of which the insert is made can be rolled or treated in any desired manner to give it the requisite physical properties before it is placed in the mold cavity. In using the expression "iron", it is, of course, understood that cast iron, if it possesses the requisite physical properties, can be used, or wrought iron may be employed, or iron mixed with various ingredients, and treated as in the manufacture of rolled products, providing, of course, that such other ingredients do not detract from the desired qualities of the alloy.

I claim:

A casting having an insert buried beneath the surface thereof and containing a sufficient quantity of manganese to render it immutable to varying temperatures.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this 5th day of January, 1910.

CHARLES T. WESTLAKE.

Witnesses:
M. P. Smith,
L. Corrao.

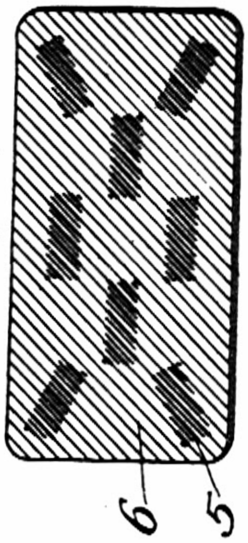
F. E. CANDA.

PROCESS OF PRODUCING COMPOSITE BARS.

APPLICATION FILED FEB. 18, 1907.

1,107,755.

Patented Aug. 18, 1914.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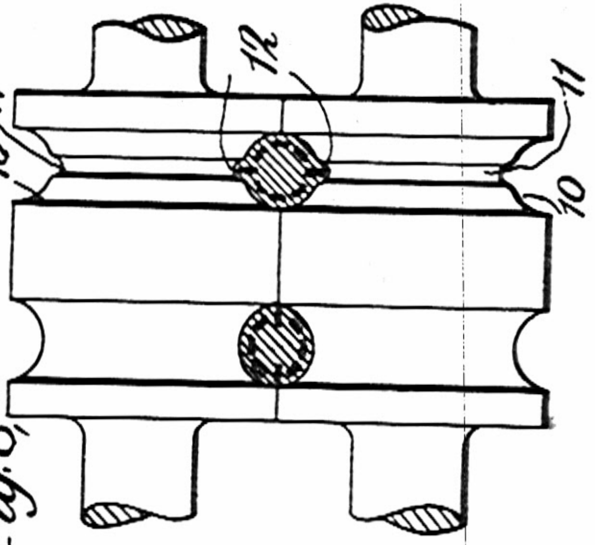


Fig. 8,

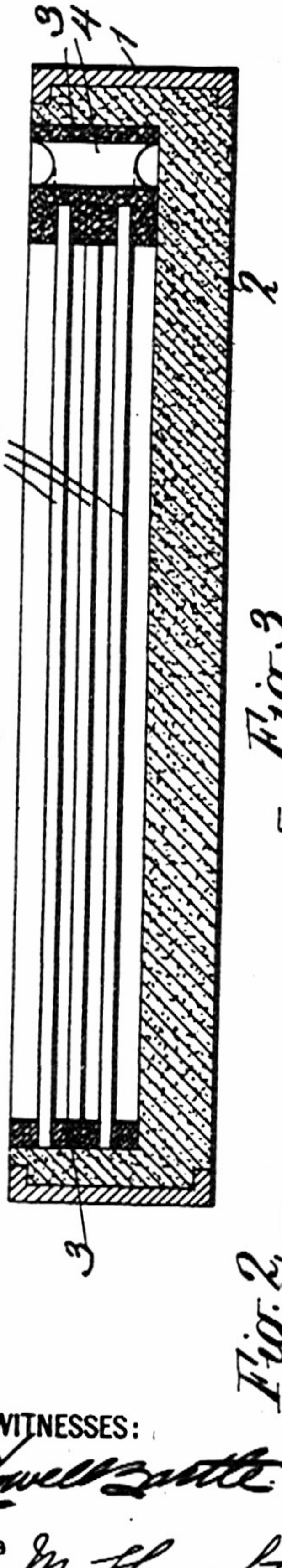


Fig. 1,

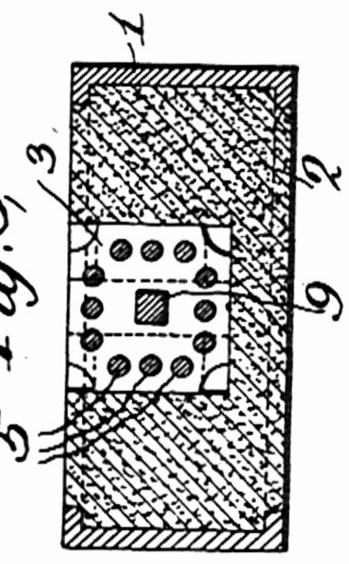
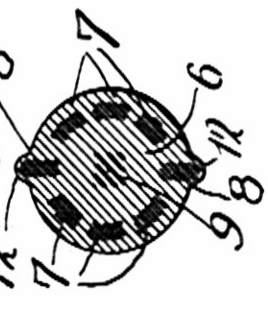


Fig. 3,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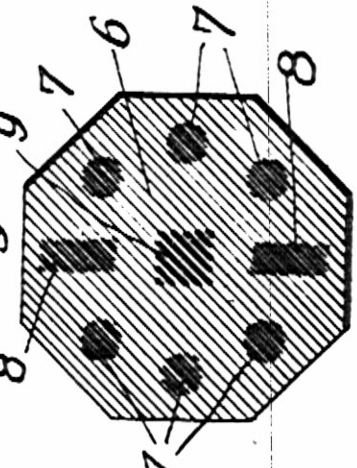


Fig. 6,

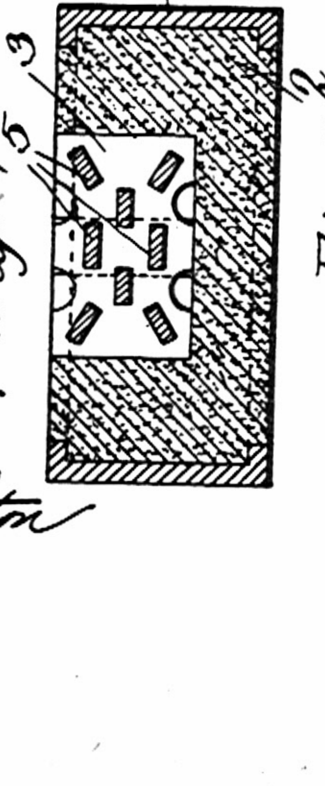


Fig. 2,

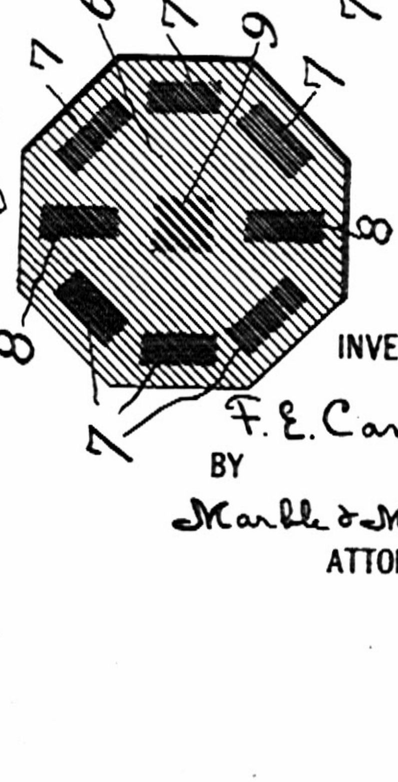


Fig. 5,

WITNESSES:

Lowell Butte

A. M. Houghton

INVENTOR

F. E. Canda,

BY

Marble & McElroy

ATTORNEYS.

UNITED STATES PATENT OFFICE.

FERDINAND E. CANDA, OF NEW YORK, N. Y., ASSIGNOR TO CHROME STEEL WORKS, OF CHROME, NEW JERSEY, A CORPORATION OF NEW JERSEY.

PROCESS OF PRODUCING COMPOSITE BARS.

1,107,755. Specification of Letters Patent. **Patented Aug. 18, 1914.**

Application filed February 18, 1907. Serial No. 357,853.

To all whom it may concern:

Be it known that I, FERDINAND E. CANDA, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Processes of Producing Composite Bars; and I do hereby declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to processes of producing composite bars, particularly jail bars and the like, and consists in a method of making composite jail bars and like articles comprising a body of relatively soft metal having interspersed therethrough a plurality of cores of harder metal, and specifically, in a method of making such composite jail bars or like articles having projecting ribs on their sides into which ribs certain of said hard cores extend.

In jail bars it is desirable to have a body of tough and flexible character (which of course, means a relatively soft steel or like metal), containing a plurality of cores or bars of harder metal so interspersed through the mass of softer metal as to prevent sawing or boring of the bar; the soft but tough metal constituting the body of the bar, preventing breaking of the bar even when the same is bent cold and permitting the bar to be shaped when either hot or cold. Such a compound bar I have described and claimed in my application Sr. No. 314,032. In the case of certain types of jail bars, and of bars for other purposes, it is desirable to have on the surfaces of such bars longitudinal ribs; and in such cases it is desirable that the hard cores or cast-in bars before referred to, shall extend up into such ribs so as to prevent sawing off or sawing through the ribs themselves. In the casting of the composite ingots for these bars trouble has sometimes been experienced in the case of large ingots, owing to "piping," which is greatly increased over what is commonly experienced in steel casting, by the presence of the relatively cold hard steel bars. It is necessary to obviate this piping as when rolling a bar with considerable piping within it the relative positions of the inserted hard metal bars may be changed materially. My present invention comprises a method of reducing or preventing this piping.

I have discovered that if a plurality of bars of hard metal be arranged in an ingot mold and soft steel or other soft metal cast thereabout so as to form an ingot, the ingot so formed may thereafter be rolled down in the ordinary manner and the cast-in bars will nevertheless retain substantially their original relative positions and substantially their original proportions with respect to the proportions of the bar itself; and in the case of the production of a ribbed bar, I have found that if in the original ingot hard steel bars be cast in edgewise in positions corresponding to the positions of the ribs in the completed bar, and if the bar be rolled down in the manner hereinafter described, these edgewise cast-in hard steel cores may be drawn up into the ribs formed in the rolling so that it is as impossible or difficult to saw or bore through the ribs as through the body of the bar itself. Such ribs will be surrounded and supported by the softer metal, making it difficult to break them loose. I have further found that piping in large ingots such as referred to above, may be prevented by placing in the mold in a position corresponding to that at which piping would otherwise occur, a bar of soft metal and causing such bar to be cast into the ingot formed.

In the accompanying drawings I illustrate the various steps in the production of the jail bars such as herein referred to.

In said drawings: Figure 1 shows a vertical longitudinal section of a mold with hard metal bars therein, said mold being prepared for the pouring of the softer and tougher metal therein. Fig. 2 shows a transverse section through such a mold. Fig. 3 is a view similar to Fig. 2, but indicates the use of a soft metal center rod to reduce piping. Fig. 4 shows a transverse section of one form of ingot such as may be used in the production of the jail bars, and the like. Fig. 5 shows another such form of ingot; and Fig. 6 still another such form. Fig. 7 shows on a larger scale than the preceding figures, a transverse section of a ribbed jail bar constructed as herein described; and Fig. 8 shows a detail elevation of reducing rolls, and illustrates the formation of the ribs thereby.

In said drawings, 1 designates the flask of the mold, 2 the green sand body of the mold, 3. 3 dry sand cores in the mold, one of them containing the runner 4, said cores supporting the inserted hard metal bars 5.

The mold having been prepared, the cores inserted and the bars 5 placed within said cores, the mold is poured in the ordinary manner, the softer metal, usually low carbon steel, rising up around the inserted rods or cores 5 and completely surrounding the same and welding thereto. In this way ingots of any of the sections shown in Figs. 4, 5 and 6 may be produced. In Figs. 5 and 6, 6 designates the tough metal body of the ingot, and 7, 7 and 8, 8 cast-in cores or bars of harder metal, such as were originally the bars 5 inserted into the mold. For preventing piping of the ingot I place within the mold a center rod of soft metal which in the final ingot produces the soft metal cast-in bar 9 indicated in Figs. 3, 5, 6 and 7.

When it is desired to form ribbed jail bars or the like, into the ribs of which hard metal cores are to be drawn, the bars which are to be so drawn up into the ribs are of rectangular or other elongated cross section, and are placed edgewise or radially, so as to produce ingots such as shown in Figs. 5 and 6 for example, in which numerals 8 designate bars which were so placed edgewise in the mold and are still arranged edgewise in the cast ingot. In reducing these ingots to final form they are rolled in the ordinary manner except that they are rolled only from the sides which these cores 8 face, and from the sides at right angles thereto. I commonly start with bars of octagonal section, though this is not essential, and work from that section to a square section and then to an oval and finally to the round ribbed section, the final pass being between rolls having circular grooves 10 (Fig. 8) at the bases of which are other grooves 11 corresponding to the ribs to be formed. Care is taken in this final pass that the hard metal cores 8 are presented exactly in registry with these ribbed grooves 11. The result is that in the final bar these cores 8 are drawn up into the ribs 12, as indicated in Fig. 7. In this rolling, at the beginning the hard steel cores may be, and commonly are, softer than the soft steel body portion of the ingot, owing to the fact that high carbon steel melts at a lower temperature than low carbon steel, and consequently at higher forging temperatures is softer than low carbon steel. Nevertheless the ingot rolls readily and without change of relative positions of the various hard steel cores. As the metal cools during rolling the hard steel cores become of the same hardness as the soft steel body, and finally become of greater hardness; and it is doubtless owing to this fact, that it is possible in the final pass for forming the ribs 12, to draw the edgewise cores 8 up into these ribs, as shown in Fig. 7.

The soft metal center bars 9 doubtless prevent piping by chilling the molten metal in immediate contact with them and at the same time welding thereto, thus causing solidification to start from the inside as well as from the outside, and providing a body of relatively strong metal to resist the disruptive stresses within the body of the ingot due to solidification at the outside. The rolling takes out whatever internal stresses there may be in the metal due to solidification both from the outside and from the center.

What I claim is:—

1. The process of producing composite bars which consists in placing hard metal bars in a spaced arrangement in a mold, pouring softer metal around said bars, rolling the resulting ingot to approximate final dimensions while preserving symmetrical form, and finally rolling at a lower temperature into ribbed form, with certain of said harder metal bars opposite the positions for said ribs, and thereby drawing such harder metal bars into the ribs so formed.

2. The process of producing composite ribbed bars which consists in placing hard metal bars in a spaced arrangement in a mold, pouring soft metal around said bars, rolling the resulting ingot at a comparatively high temperature and thereby producing symmetrical reduction of the joined metals, and subsequently completing the reduction at a lower temperature, the bar being rolled with certain of said included hard metal bars opposite rib-forming grooves of such rolls, and by the rib-forming action of such grooved rolls drawing such hard metal bars up into the ribs thus formed.

3. The process of producing composite ribbed bars which consists in placing hard metal bars in a spaced arrangement in a mold, certain of said bars which are to be included in the ribs when formed, being of elongated section and being placed with their edges toward the side of the mold, pouring soft metal around said bars, and rolling the resulting ingot in a plurality of passes, the last pass being between grooved rib-forming rolls, with the edgewise included hard metal bars opposite the positions for the ribs, whereby such hard metal bars are drawn up into the ribs so formed.

4. The process of producing composite ribbed bars which consists in placing hard metal bars in a spaced arrangement in a mold, certain of said bars which are to be included in the ribs when formed, being of elongated section and being placed with their edges toward the side of the mold, pouring soft metal around said bars, and rolling the resulting ingot in a plurality of

passes on the sides nearest such edgewise turned bars, and on the sides at right angles thereto, the final pass being between grooved rib-forming rolls, with the edgewise included hard metal bars opposite the positions for the ribs, whereby such hard metal bars are drawn up into the ribs so formed.

5. The herein described process of producing composite jail bars and the like, which consists in placing in a suitable mold in spaced arrangement a series of cores of hard metal, said cores relatively arranged in the outline of a closed figure inclosing a central space, pouring molten softer metal into said mold and about said bars and within the space inclosed thereby, and finally working down the ingot so formed.

6. The herein described process of producing composite jail bars and the like, which consists in placing in a suitable mold a series of cores of hard metal in a spaced arrangement in the form of a closed figure inclosing a central space, and further placing in the mold a soft metal bar in a position approximating the center of the ingot to be formed, pouring softer metal into said mold and about said bars, and finally working down the ingot so formed.

In testimony whereof I affix my signature, in the presence of two witnesses.

FERDINAND E. CANDA.

Witnesses:

ALPHONSE KLOH,

H. M. MARBLE.

March 9, 1926. 1,576,317 65

C. E. EKLIND

METHOD OF FORMING REENFORCED CASTINGS

Filed April 16, 1925

Fig. 1.

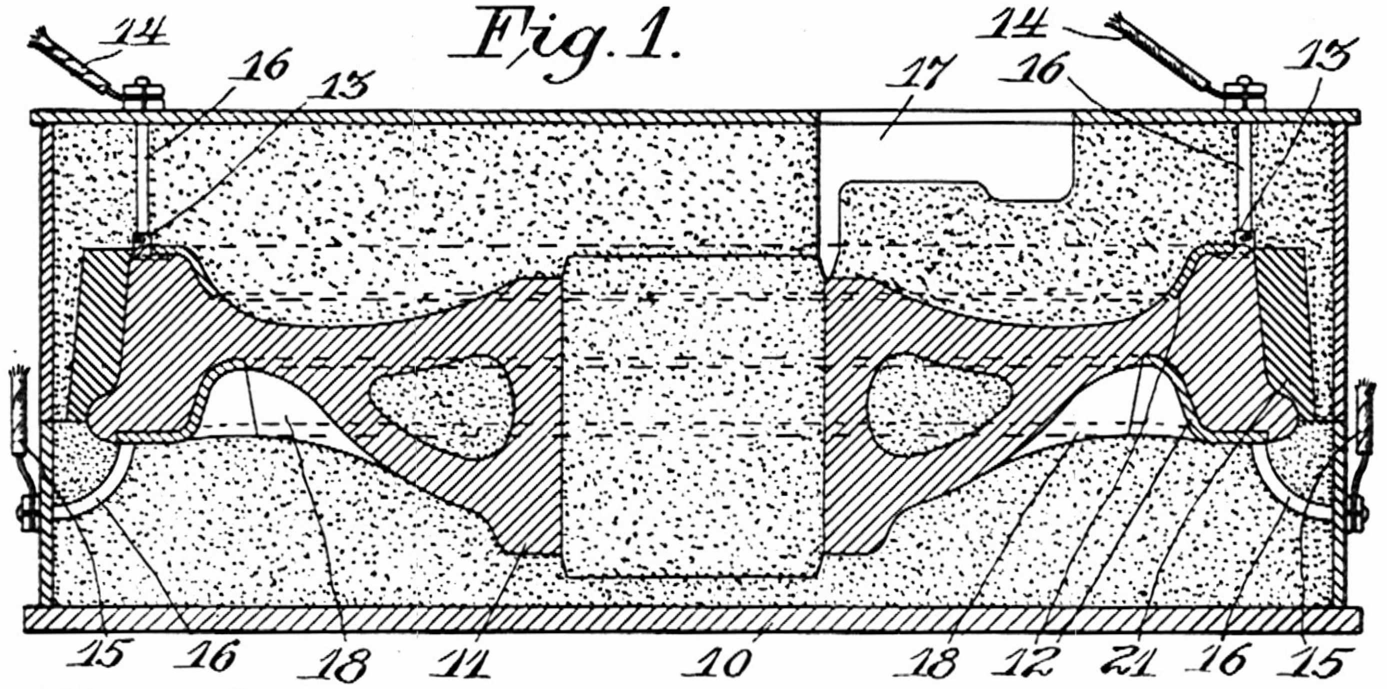


Fig. 2.

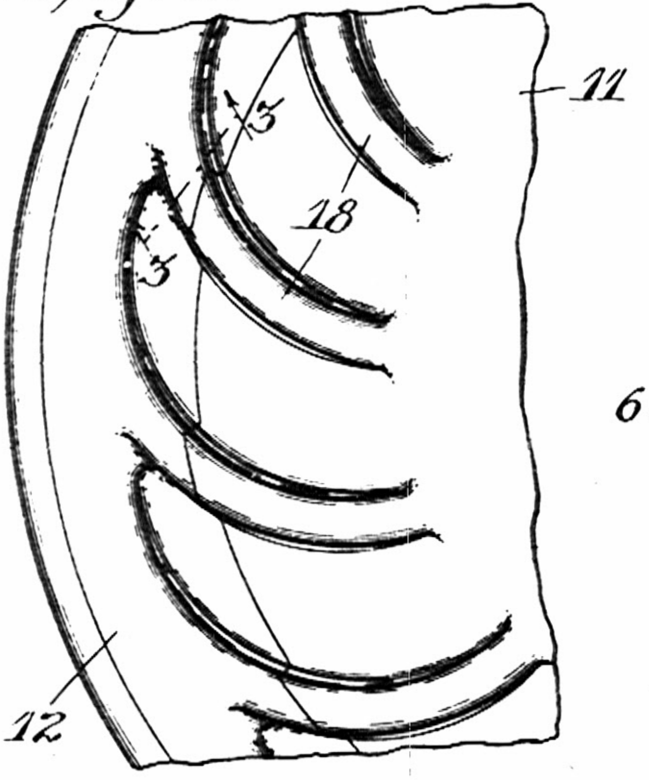


Fig. 5.

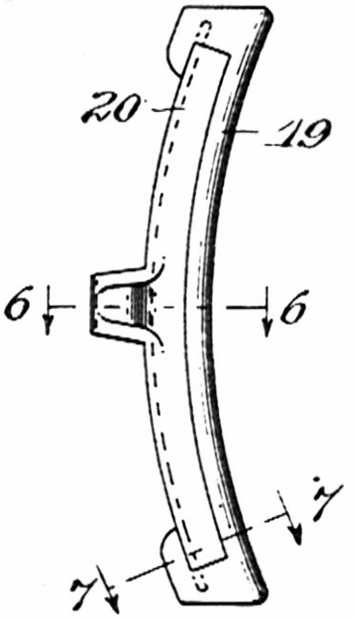


Fig. 6.

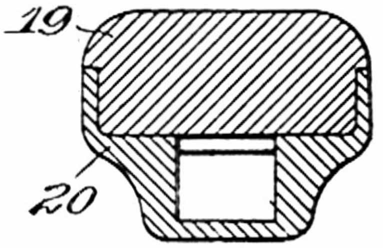


Fig. 7.

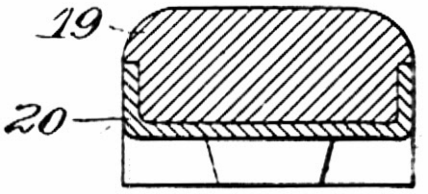


Fig. 3.

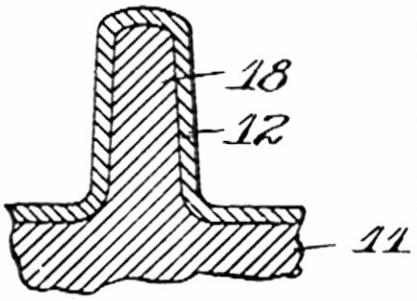
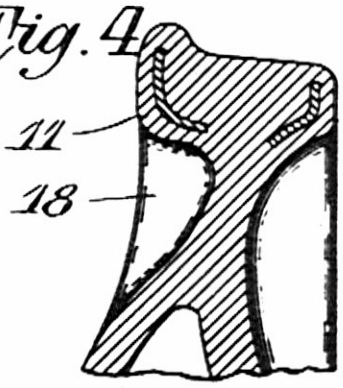


Fig. 4.



Inventor.
Carl E. Eklind
By Paul O. Pippel
Atty.

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Patented Mar. 9, 1926. **1,576,317**

UNITED STATES PATENT OFFICE.

CARL E. EKLIND, OF BERWYN, ILLINOIS.

METHOD OF FORMING REENFORCED CASTINGS.

Application filed April 16, 1925. Serial No. 23,469.

To all whom it may concern:

Be it known that I, CARL E. EKLIND, a citizen of the United States, residing at Berwyn, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Methods of Forming Reenforced Castings, of which the following is a full, clear, and exact specification.

My invention relates generally to a method and means for making reenforced castings and particularly to a method of forming such reenforced castings during the molding operation or manufacture thereof.

An object of this invention is to devise a simple and inexpensive method for reenforcing castings in the process of manufacture, and particularly strengthening such parts of castings as are subjected in service to the greatest stresses, to the end that objectionable strains and breakages in the castings during service are effectually prevented.

A further object is to form castings having strengthened portions formed during manufacture by means of inserts or inlays of tougher and greater stress and strain resisting quality than the main body of the casting.

Still another object of this invention is to have such strengthening inserts and inlays become an integral part of the casting which cannot become loose therefrom.

As the description hereof progresses, other objects and advantages should become obvious to anyone skilled in this art. While it should be understood that this invention is applicable to the manufacture of all kinds of castings, and especially metallic castings, nevertheless, I have chosen in the present preferred embodiment to illustrate the same in connection with the manufacture of improved castings for railway appliances, as this field presents a great variety of metallic, and particularly castings of ferrous metals, where the present improvement could be effectively employed.

Briefly stated, the invention comprises the following method of forming reenforced castings, wherein the mold is first prepared in the conventional manner. Reenforcing inserts or inlays of material tougher than the main body of the casting are then supported in proper position in the mold, the same having been preheated to a welding temperature, either heated before or after being placed in the mold in any suitable manner, as by means of electricity, to such a temperature as will approximate as nearly as possible, without melting, the temperature of the metal to be poured into the mold. The metal to be poured is heated to a temperature in excess of its melting point and is then poured into the mold and around or against the insert or inlay which absorbs the excess heat of the poured metal, the two metals then welding together and adhering in a manner to form an integral, unitary casting.

As already stated this method could be advantageously employed in the railway car rigging art where such castings as car wheels, brake shoes, side truck frames and bolsters are subjected to great stresses causing many breakages, and accordingly I have chosen to illustrate in the accompanying drawings a car wheel and brake shoe to show the manner of strengthening such particular castings.

In the drawings,—

Fig. 1 is a sectional view of a conventional mold showing the manner of forming a reenforced car wheel therein;

Fig. 2 is a plan view illustrating a segmental fragment of one face of such wheel with the reenforcing inlay welded thereon;

Fig. 3 is a detail sectional view showing the inlay welded over the usual ribs or brackets of standard car wheels, and is taken along line 3—3 of Fig. 2, looking in the direction of the arrows;

Fig. 4 is a sectional detail of a wheel formed with reenforcing inserts rather than inlays and is a modification of the first disclosure;

Fig. 5 is a side view of a form of brake shoe with a reenforcing back piece cast integrally with its body;

Fig. 6 is a sectional view thereof along line 6—6 of Fig. 5, looking in the direction of the arrows; and

Fig. 7 is a similar view along the line 7—7 of Fig. 5, looking in the direction of the arrows.

To illustrate the improved method of casting better castings, a conventional two-part molding flash 10 is shown, the same being filled with sand and hollowed out in the usual way for pouring metal thereinto, such as cast iron, to mold the standard railway car wheel 11 shown therein. Each side edge adjacent the flange of these standard cast iron wheels soon chips and fritters off due to the strain of usage, and the object here is to strengthen these portions of the wheel in a manner to overcome this difficulty. Accordingly, there is placed in the mold, as shown, a pair of annular ring members 12 of tougher material than the wheel proper, such for example as wrought iron or open hearth steel, are placed in the mold as shown, the lower annulus lying properly in the mold hollow while the upper one must be supported by chaplets 13 of any suitable kind. Obviously, of course, these ring members must be shaped to conform with the faces of the marginal edges of the wheel adjacent the flange. These ring members then are connected in electric circuits, where they become in effect resistance elements, and by means of electric current of the necessary voltage are heated to a temperature as nearly as possible approximating the temperature of the molten metal to be poured to form the main body of the casting without melting and destroying the form of these rings. The circuit leads for the upper ring are shown at 14 while those for the lower ring are shown at 15. Both rings could, of course, be included in a single circuit, if desired. Insulated conductors 16 are employed to pass the current through the sand to the rings. When the rings are properly preheated the current may be cut off and the cast iron poured into the mold at 17 in the usual way, the metal completely filling the hollow in the mold and contacting the preheated rings of different material. The two metals are then permitted to cool slowly together to insure equal shrinkage, the metals in effect at their contacting surfaces securely welding or amalgamating together to form an integral wheel, which will be materially strengthened in those places where the stresses will be greatest. One face of the standard wheel is provided with the usual brackets or ribs 18, as shown, and the strengthening ring of different material, as shown in Figs. 1, 2 and 3, may be formed over these ribs. The chaplets 13 will become a part of the finished casting very likely, as they may be made to unite with either the ring or casting proper. The upper insulators 16 may be arranged to support these chaplets as shown. These strengthening inlays or rings may, of course, be preheated in any other way and may even be heated before being placed in the mold. Each insert or inlay ring could be of a different metal to meet any particular kind of stress; that is, the completed casting could be an integral unit of three different metals.

In Fig. 1, a chill 21 is shown in the mold for the purpose of chilling and hardening the wheel tread or tire, as is usually done. This will in no way interfere with the method herein disclosed.

Fig. 4 shows a modified wheel wherein the molten metal is cast completely around strengthening inserts by the present method. Here the inserts could be perforated so that the poured metal could take a better grip on the insert.

A brake shoe 19, as shown in Figs. 5, 6 and 7, having a main body of iron may also have a strengthening back 20 of tougher material, such as steel, integrally formed thereon by my method.

Obviously the method is applicable to the formation of any castings to be made of different metals and particularly in the integral formation of a tougher wearing or strain and stress resisting surface or part for such castings.

Striated surfaces and interlocking projections could also be formed on the surfaces of the reenforcing part to insure a tight weld with the main body of the casting, if desired.

The terms "weld" and "welding" herein employed are intended to mean the uniting of the different metals as by the adherence of one with the other due to the heat at their contacting surfaces and not in the sense of alloying the different metals. In practice the metal to be poured will be heated somewhat above its melting point so that its surplus heat will be absorbed by the reenforcing pieces to insure a better adherence between the different metals. This, for the reason that the inlay pieces 12 can be preheated only to a certain extent. They must not be heated too much lest they lose their shapes and they must, of course, also retain their positions in the mold, which they cannot do if heated too much. The superheat of the poured metal is absorbed by the inlays and they cannot then lose their preformed shapes because the poured metal fills the mold and holds them in position. With the inlays disposed on the outside as shown in Figs. 1, 2 and 3, the wheel is formed with a hard, tough, outer reenforced surface in a manner best conducive to resist wear and strain. Obviously, the inlays could be in the form of disks and form a cover for the entire face of the wheel.

Although I have illustrated the preferred embodiment of my invention, it will be evident that various changes in the method may be made without departing from the spirit of the invention, and, therefore, I do not limit myself to the exact disclosure made as indicated in the subjoined claims.

What I claim is:

1. The method of forming reenforced cast wheels comprising preheating preformed reenforcing pieces of one metal in a mold to substantially the highest temperature they will stand without losing their shapes, the pieces being so placed in the mold that one will be on the outside of each face of the

finished wheel, then pouring a molten metal of a different quality and at a temperature in excess of its melting point into the mold against and between the reenforcing pieces, such reenforcing pieces absorbing such excess heat and welding with the poured metal, the metals then cooling and shrinking together to form an integral cast wheel having faces provided with exposed reenforcing pieces.

2. The method of forming a reenforced cast wheel which consists in supporting preformed annular tough, ferrous pieces in a mold hollow, preheating the pieces in the mold to the highest temperature which they will stand without losing their preformed annular shapes, then pouring a molten ferrous metal of a different quality at a temperature in excess of its melting point into the mold hollow against the preformed pieces the pieces absorbing the excess heat of the poured metal and welding therewith, the metals then cooling and shrinking together to form an integral cast ferrous wheel having exposed reenforcements thereon.

3. The method of forming reenforced castings having exposed reenforcing pieces, comprising properly supporting and positioning hard preformed reenforcing pieces of one metal in a mold hollow and preheating them to a temperature which will transform them to a soggy state without destroying their shapes, then pouring a molten metal of a different quality and at a temperature in excess of its melting point into the mold against the reenforcing pieces, the said pieces absorbing such excess heat and welding with the poured metal, the metals then cooling and shrinking together to form an integral casting having exposed reinforcements thereon.

In testimony whereof I affix my signature.

CARL E. EKLIND.

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Dec. 1, 1931. M. R. TREMBOUR ET AL 1,834,750

PROCESS FOR MANUFACTURING JAILBAR STEEL INGOTS

Filed April 18, 1930

Fig 1

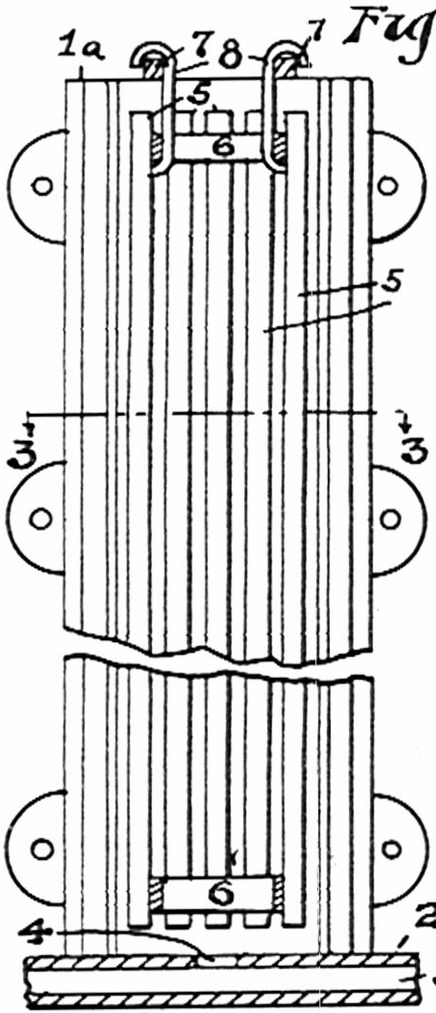


Fig. 3

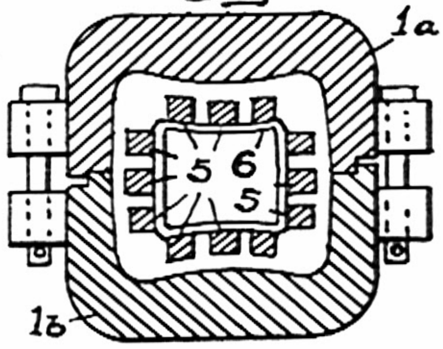


Fig. 4

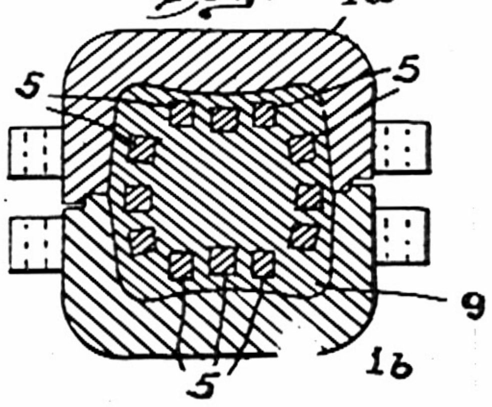


Fig. 5

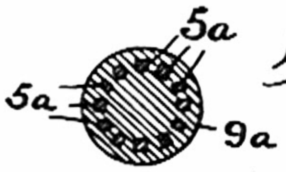


Fig. 6

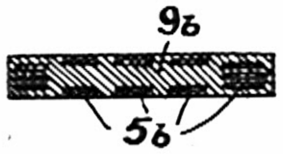
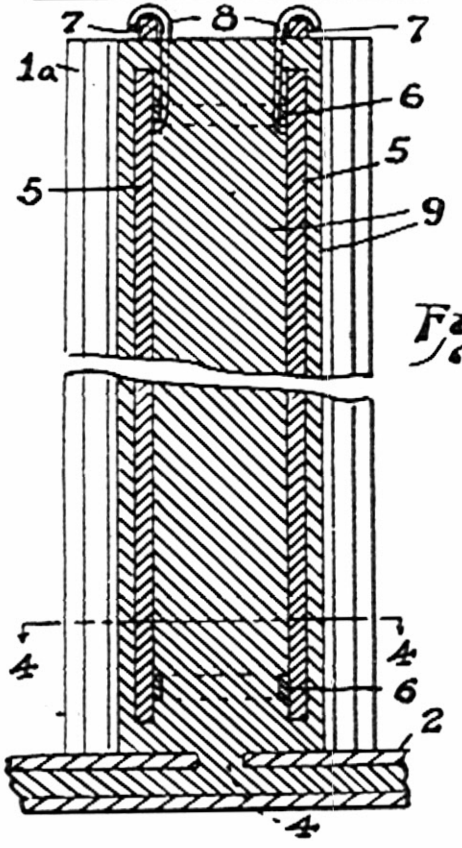


Fig 2



INVENTORS.
Max R Trembour
and John A. Auth
by Edward A. Lawrence
their attorney.

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Patented Dec. 1, 1931 **1,834,750**

UNITED STATES PATENT OFFICE

MAX R. TREMBOUR, OF BEAVER BOROUGH, AND JOHN A. AUTH, OF MOON TOWNSHIP, BEAVER COUNTY, PENNSYLVANIA, ASSIGNORS TO COLONIAL STEEL COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA

PROCESS FOR MANUFACTURING JAILBAR STEEL INGOTS

Application filed April 18, 1930. Serial No. 445,398.

Jailbar steel is used in detention institutions, such as jails and prisons, and also for the protection of banks and other depositaries of valuables, and the like.

To adequately serve such purposes the bars or plates must be difficult to break or shatter as by the blows of a sledge hammer and must also be difficult to cut as by a file or saw.

Thus jailbar steel is characterized by a body of relatively soft steel, which cannot be readily shattered or broken, and inserts of relatively hard steel which cannot be readily cut.

The relative positioning of the hard steel inserts in the soft steel body is a feature of the greatest importance but difficult to accomplish.

It is necessary to place the inserts as near as possible to the surface so that the cutting of the soft steel to a material extent may be prevented. Otherwise the soft steel body might be cut or notched and the inserts shattered or broken by a blow at the notched portion. Again, if the inserts be placed directly at the surface of the soft steel they may be first shattered and the soft steel then cut through. Again this placement of the inserts presents practically insurmountable difficulties in manufacturing due to cracking of the ingot.

Again inserts which are relatively positioned in an improper manner are exposed to individual attack and may be cut through one at a time.

One of the characteristic features of our invention is a jailbar whose inserts are placed near but not at the surface of the soft steel so that no material cutting of the latter may be accomplished without encountering and attacking the inserts, and also whose inserts are relatively positioned in such manner that they cannot be attacked and cut one at a time.

The casting of a jailbar ingot is a difficult operation owing to the number of inserts which must be incorporated in the ingot and near the outer surfaces of the latter, and which must be uniformly covered and inclosed by the soft steel.

We have therefore invented a new and improved process for producing such ingots.

One of the characteristic features of our improved process is the bottom-casting of the soft steel into a vertically disposed mold.

We first assemble the hard steel inserts into rigid relationship with each other, forming what might be termed a cage, a support, such as a steel ring being welded or otherwise secured to each end of the inserts so as to hold them in proper position in the mold. The rings are of soft steel similar to the soft steel which is to form the body of the ingot.

The cage thus formed is then inserted downwardly into the mold and suspended from above therein. The ends of the cage stop short of the upper and lower ends of the mold so that the ends of the inserts are entirely covered by the molten soft steel.

The ingot is then removed from the mold and rolled or worked to final form in the usual manner.

In the accompanying drawings, wherein we have illustrated a practical embodiment of the principles of our invention, Fig. 1 is an elevation of one-half of a split ingot mold with the cage of inserts suspended therein, the cage being shown in vertical section.

Fig. 2 is a similar but broken view showing the soft metal body cast in the mold.

Fig. 3 is a cross-sectional view taken along the line 3—3 in Fig. 1.

Fig. 4 is a similar view taken along the line 4—4 in Fig. 2.

Fig. 5 is a cross-sectional view of a round jailbar rolled from the ingot shown in Figs. 2 and 4.

Fig. 6 is a cross-sectional view of a plate rolled from the ingot illustrated in Figs. 2 and 4.

Referring to the drawings, 1*a* and 1*b* represent the two parts of a vertical "split" ingot mold mounted on a base 2 which is provided with a channel 3 and port 4 for the bottom-casting of the molten metal into the mold.

5 represents the hard steel inserts which may be and preferably are of chrome-manganese alloy. The bars are of proper cross-sectional area to provide the proper area in the finished jailbar, such as shown in Fig. 5.

The bars 5 are assembled and secured together in proper relation before they are inserted into the mold.

Thus we may and preferably do weld the bars adjacent to their upper and lower ends to the rings 6 which are of soft steel similar to the soft steel which is to be poured into the mold 1*a*—1*b*. These rings 6 are on the inside with the inserts welded or otherwise secured to the outer perimeter of the rings. The rings are preferably provided with flat surfaces against which the inserts are welded.

The ingots are usually cast with a substantially square or rectangular cross-sectional shape and thus the rings are of the proper shape to properly position the inserts relative to the body of soft metal in which the inserts are to be enveloped.

The cage thus formed of hard steel inserts and soft steel rings is suspended from above in the otherwise empty ingot mold with the lower end of the cage spaced above the bottom of the mold and the upper end of the cage below the top of the mold.

In practice we suspend the cage in place by means of steel struts or bars 7 placed on top of the mold, and steel hooks 8 whose upper ends are hooked over the bars 7 and whose lower ends are hooked over the top ring 6. Four of such hooks 8 may be used, two suspended from each strut 7.

The soft metal 9, which is usually low carbon steel, is then bottom-cast in the mold and filled up to the top of the mold or above the upper end of the inserts 5. The soft metal envelope covers the lower end of the inserts and also covers the upper ends of the inserts to a sufficient degree to permit the pipes to be cut off the upper end of the ingot without cutting the inserts.

When the ingot has hardened, the split mold is opened and the ingot removed, and it is then worked in the usual manner to final form, such for instance as illustrated in Fig. 5 wherein the reduced inserts are shown at 5*a* and the soft steel body at 9*a*. In the working the material of the rings 6 becomes incorporated in the like steel of the body 9*a*.

The positioning of the inserts 5 relative to the soft steel body 9 of the ingot is of the greatest importance. We have illustrated our improved arrangement and it will be there noted that in the finished bars these inserts are placed near but not at the surface of the soft steel body, so that no material cutting of the soft steel can be accomplished before the file, saw of other cutting tool encounters one or more of the inserts. Again the soft steel cannot be notched sufficiently to allow the inserts to be shattered by a blow.

It will be noted that the inserts are sufficiently numerous and are so placed relative to each other that no one insert may be separately attacked. In other words before one insert can be materially cut into the tool will encounter another insert or inserts, thus rendering the attempt to sever the inserts practically abortive.

In Fig. 6 we have illustrated the ingot rolled out into the form of a flat bar or plate, the soft steel body being indicated at 9*b* and the inserts at 5*b*.

We claim:—

1. The process of manufacturing jailbar ingots which comprises assembling a plurality of hard steel inserts into a cage, having its center open throughout its length, by securing the inserts to the outer perimetrical surfaces of rings of soft steel, suspending said cake in a vertical position in a vertically disposed mold with the inserts out of contact with the wall of the mold, and casting the mold full of soft steel.

2. The process of manufacturing jailbar ingots which comprises assembling a plurality of hard steel inserts into a cage, having its center open throughout its length, by securing the inserts to the outer perimetrical surfaces of rings of soft steel, suspending said cage in a vertical position in a vertically disposed mold with the inserts out of contact with the wall of the mold and the ends of the inserts being spaced within the top and bottom of the mold, and casting the mold full of soft steel, the soft steel covering both ends of the inserts.

Signed at Monaca, Pa., this 15th day of April, 1930.

MAX R. TREMBOUR.
JOHN A. AUTH.

BRIEF FOR APPELLEE

United States Court of Appeals

DISTRICT OF COLUMBIA

APPEAL NO. 8859

ERNST ZINGG AND SULZER FRERES, SOCIETE ANONYME,
APPELLANTS

v.

CONWAY P. COE, COMMISSIONER OF PATENTS, APPELLEE

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

W. W. COCHRAN,
Solicitor, United States Patent Office,
Attorney for Appellee.

UNITED STATES
COURT OF APPEALS FOR THE
DISTRICT OF COLUMBIA

FILED DEC 18 1944

Joseph W. Stewart
CLERK

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United States Court of Appeals

DISTRICT OF COLUMBIA

APPEAL NO. 8859

ERNST ZINGG AND SULZER FRERES, SOCIETE ANONYME,
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v.

CONWAY P. COE, COMMISSIONER OF PATENTS, APPELLEE

APPEAL FROM THE JUDGMENT OF THE DISTRICT COURT OF THE UNITED STATES FOR THE DISTRICT OF COLUMBIA

BRIEF FOR THE COMMISSIONER OF PATENTS

This is an appeal from the judgment (12)[1] of the District Court of the United States for the District of Columbia dismissing the complaint (2) in which appellants sought to have the Court authorize the Commissioner of Patents to issue to them a patent containing claims 12 to 16, inclusive, of the patent application No. 319,597, of appellant Ernst Zingg.

APPELLANTS' APPLICATION

Appellants' application (30) relates to cast metal parts and to a method of increasing the strength thereof by inserting within the casting metallic inserts having a modulus of elasticity different from that of the body of the casting. Appellants' theory seems to be that if the inserts are properly positioned within the body of the casting in relation to the lines of force therein, the latter will be dispersed with the result that the strain on the material of the casting will be distributed throughout a greater portion thereof than would be the case if the inserts were omitted.

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[1] The numbers in parentheses throughout this brief refer to pages of appellants' appendix.

Claims 12 and 16 (4, 5) are representative of the claims on appeal and read as follows:

> 12. A metallic casting having embedded in and integrally attached thereto, a metallic insert member whose modulus of elasticity is different from the modulus of elasticity of the cast metal, the insert member intersecting the lines of force in the casting and extending away from the area of maximum stress toward areas of lesser stress.
>
> 16. A metallic casting having regions of higher and regions of lower stresses, a reinforcing member embedded therein, completely enclosed by the body thereof having its entire superficial area integrally attached thereto and located in a region of lower stress, and having a modulus of elasticity greater than the modulus of elasticity of the body of the casting.

All of the appealed claims were found by the lower court (11) to be unpatentable in view of certain patents, which will now be discussed.

THE PRIOR ART

The patent to Roberts (45), No. 209,836, of November 12, 1878, relates to the manufacture of cranks. In the patent it is stated that the object of the invention is to reenforce the crank pin. As shown in the drawings the material of the casting extends continuously from one part *a* to the other part *a* and there is provided at the crank portion *b* a reenforcing member *P* shown in Fig. 4, which member has its ends embedded within the portions *c* of the casting and has its central portion exposed to form a crank bearing. It is stated in the patent (46) that the metal of which the pin *P* is formed is preferably steel. From this statement it is obvious that the material of this member has a modulus of elasticity different from that of the casting.

The Armstrong patent (51), No. 1,718,210, of June 25, 1929, relates to the process of making hollow drill rods. As stated in the patent, it is customary to make rock drills of hard steel in order to penetrate rock formations and these drills are subject to breakage because of the tremendous vibratory stresses encountered in use. To remedy this situation Armstrong placed tough reenforcements within the hard steel of the rock drill, which reenforcements, being tough rather than brittle and hard, would prevent breakage of the drill. Various forms of reenforcements are shown in Figs. 4 to 11, inclusive, of the drawing (52). In Fig. 11, for example, the reenforcements are the concentric tubes *14b* and *14c* and these are said to be made preferably of low carbon steel. This material, of course, has a modulus of elasticity different from that of the hard steel forming the body of the drill.

The patent to Westlake (58), No. 980,719, of January 3, 1911, relates to the art of casting. The patent describes the prior practice of molding inserts within the castings for the purpose of strengthening the casting and providing a metal insert having different physical properties from the metal which is cast around it. (59, lines 19 to 25.) The particular purpose of the Westlake invention was to provide an insert made of the material whose properties would not be affected by the heat to which it is subjected in the casting process. In this case it is clear that the insert is entirely embedded within the body of the casting and differs therefrom in physical properties, such as elasticity.

The patent to Canda (62), No. 1,107,755, of August 18, 1914, and the patent to Trembour et al. (69), No. 1,834,750, of December 1, 1931, relate to jail bars. In order that such bars be effective it is necessary that they have sufficient strength and toughness to withstand blows which might break a bar made of hard, brittle metal. At the same time they must have components at least which are sufficiently hard to withstand sawing or filing. To meet this problem both of the patentees just mentioned produce bars made of tough steel, with inserts made of hard metal. In the Canda patent (61) the hard reenforcing bars are shown at 5 in Fig. 4, the main body of the bar, made of softer and tougher materials, being shown at 6. A similar arrangement is shown in Fig. 4 of the Trembour et al. patent.

The Eklind patent (65), No. 1,576,317, of March 9, 1926, relates to a method of making reinforced cast wheels, such as car wheels. The patent states (66, lines 25 to 28) that the reinforcement is by means of inserts or inlays made of tougher and greater stress and strain resisting quality than the main body of the casting. These reinforcing members, as shown in Fig. 4, are embedded entirely within those portions of the car wheel which are subjected to the greatest strain. Obviously the elastic characteristic of these inserts is different from that of the material of the wheel.

SUMMARY OF ARGUMENT

The structure recited in the claims is found in the prior art patents. Consequently the appealed claims are unpatentable. It is immaterial that the appellant Sulzer Freres may have stated in their application a theory which is not set forth in the prior art.

ARGUMENT

It will be obvious from an inspection of the patents discussed above that each of them discloses a casting having reinforcing metallic inserts which are either wholly or partially inclosed within the casting. It will be equally clear that in each case the metal of the insert has a modulus of elasticity which is different from that of the metal of the casting.

Appellants do not challenge this fact (Br. 18) but base their argument for patentability on the location or disposition of the inserts within the casting. Claim 12 states that the insert member intersects the lines of force in the casting and extends away from the area of maximum stress toward areas of lesser stress. First it should be noted that the location of the lines of force is not a characteristic of the casting, for they come into existence only when a force is exerted on the casting and the application of forces on different parts of the casting would produce different dispositions of the lines of force. But passing over this possible objection, it is submitted that the language of the claims is not such as to distinguish from the prior patents. Considering, for example, Fig. 4 of the Eklind patent (65) the insert shown at the left "extends away from the area of maximum stress" which is the flange of the car wheel, and "toward areas of lesser stress", namely, the web of the wheel.

The language of the claims is so broad as to apply to the crank structure of Roberts (45) for, as pointed out by the examiner (41), the crank pin *b* extends through a relatively wide cross section of the device and would apparently cut lines of force in both high stress areas and low stress areas.

In the Canda patent (61) the areas of greatest stress when the bar is subjected to a bending stress are at the periphery of the bar. The insert 8 in Fig. 6 certainly intersects the lines of force and extends away from the area of maximum stress, the periphery of the bar, toward areas of lesser stress, the interior of the bar.

Claim 13 is similar to claim 12 and claim 14 requires no additional comment except that the claimed integral bonding of the insert to the casting is clearly shown in the cited patents.

Claim 15 is for a method which merely amounts to embedding an insert in a casting in some unspecified location to produce a certain effect. This claim is obviously unpatentable for the same reasons as claims 12 and 13.

Claim 16 would seem to read directly on either the Eklind patent (65) or on the Canda patent (61).

Appellants base their argument solely on a theory as to how the disposition of lines of force in a body may be changed by the presence of an insert made of a different material. But appellants have produced no evidence to controvert the conclusion of the Board of Appeals which is set forth in their decision as follows (44):

> * * * We are not convinced that appellant's location of his inserted material would have any special effect in spreading the stresses but even aside from that, we think that the claims do not differ in terms from the prior art as discussed by the examiner. As far as structure is concerned, the claims involve introduction of a metal having a different character from the cast iron within the cast product.
>
> The method claim is unwarranted as not defining a proper method. As far as the method is concerned, it merely involves inserting a metal of another character in an iron casting, which is obviously not patentable.

Even if it were shown that a particular location of the inserts within a casting would be advantageous, it is submitted that the claims on appeal fail to set forth this feature with sufficient definiteness either to avoid the prior patents or to meet the requirements of Section 4888 R. S. (U. S. C., title 35, sec. 33).

The discovery of the scientific explanation of the operation of a device or the reason for a known effect is not a patentable invention. *In re Langdon,* 22 C. C. P. A. 1245, 77 F. (2d) 920; *In re Treuting,* 22 C. C. P. A. 1095, 76 F. (2d) 310.

CONCLUSION

It is submitted that the lower Court properly held the claims unpatentable and that its judgment should be affirmed.

W. W. COCHRAN,
Solicitor, U. S. Patent Office,
Attorney for Appellee.

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